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In November 1990, Oregon voters approved Ballot Measure 5, placing an ultimate ceiling on local property tax rates of 1.5% of market value (excluding specific levies for capital expenditure). Any resulting shortfalls in local education revenues are to be made up by transfers from state funds, at the expense of other programs. In this study, a state-level computable general equilibrium model (CGE) was used to investigate economic adjustment to Measure 5 in Oregon. The numerical CGE model was constructed using empirical data for a base year (1990), and coded for solution using PC GAMS. A survey of CGE applications and tax policy literature provided the context for the analysis. Three different scenarios were constructed by changing the hypothesis that revenue shortfalls directly affect education programs, non-education programs, or are replaced by other tax revenues. Results for each scenario were compared under different assumptions regarding the mobility of labor, productive capital and financial capital. Estimates of general equilibrium adjustment in output, exports, imports, household income, government revenues and other variables were calculated. In particular, implications for the distribution of income among low, medium and high income households were examined.

Tax and Budget Policy in Oregon:

A Computable General Equilibrium Perspectives

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Edward C. Waters

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CHAPTER 1

INTRODUCTION

Over the past decade the Oregon economy has seen dramatic change. International competition and increasing demand for in situ natural resource stocks have reduced the importance of extractive industries in the region's economic base. Population growth, migration, urbanization and technological change have all intensified this trend. Perceived deterioration in environmental quality has prompted concern over how Oregon's vast publicly owned resources are being managed (Oregon Progress Board; Whitelaw).

In recent years the problem of funding public services has also received increasing attention. The success of Ballot Measure 5 in November 1990, by limiting local property tax rates, has given the debate particular urgency. Oregon voters approved Ballot Measure 5 in November 1990, placing an ultimate ceiling on local property tax rates of 1.5% of assessed market value, excluding tax levies for capital expenditures. The limit on the non-school tax rate is 1% of assessed value. The school tax rate is being reduced over a five year period, from 1.5% of assessed property value in FY 1992 to 0.5% by FY 1996. Any resulting shortfalls in local education tax revenues will be made up by transfers from state general funds, at the expense of other programs. In response, a number of replacement revenue schemes have been considered, and state and local government spending priorities are being reassessed. However, even granted politically acceptable replacement revenues, reduced local education budgets and/or a major reallocation of state general fund expenditures are likely (Weber, Steel and Mason).

Policy makers rely on educated guesswork and mathematical models to forecast the impacts of alternative policies. Economists currently use an array of policy analysis tools, including econometric forecasting models and fixed price simulation models. The Oregon revenue models use statistically estimated parameters and exogenous estimates of U.S. economic trends to forecast regional economic performance (Warner and Griffiths). Regional econometric models are commonly criticized for reliance on annual forecasts of national trends as exogenous input variables. Incomplete accounting treatments (i.e. receipts not necessarily equal to expenditures) also limit the opportunity for theoretically consistent interpretation of results.

Fixed-price input-output (IO) and Social Accounting Matrix-based (SAM) models provide internally consistent representations of regional economic structure from a general equilibrium perspective, albeit under very restrictive assumptions. Ideally suited to estimating the short-term impact of changes in final demand, fixed-price models are limited in their applicability to analysis of supply-side phenomena and taxation/revenue policy. Among the restrictive assumptions used in fixed-price models are fixed-proportion production and consumption functions, perfectly elastic factor and commodity supply relationships and perfectly elastic demand for regionally produced goods and services. In general, IO multipliers provide, at best, an upper-bound on the regional supply response to an exogenous economic disturbance (Harrigan and McGregor).

Computable General Equilibrium (CGE) models combine the advantages of econometric and IO models, strengthening the theoretical basis of the modeling effort and enabling examination of a broader set of policy issues. The structure of a CGE is consistent with neoclassical economic theory and flexible enough to incorporate factor and commodity substitution into the structure of production and demand. A CGE consists of a Walrasian system of equations representing the equilibrium behavior of factor and commodity markets and other economic institutions. After calibration using base year data, the system can simulate economic response to changes in policy variables vis a vis a base scenario. Endogenous prices adjust until factor and commodity market equilibrium conditions are satisfied. Compared with fixed-price models, CGE's flexible-price structure can approximate longer-term equilibrium adjustments.

CGE Modeling

The first operational CGE model was developed for the Norwegian economy in 1960 using a tractable log-linear specification (Johansen). The recent development of accessible, numerical solution algorithms, including GAMS (General Algebraic Modeling System--see Brooke, Kendrick and Meeraus) stimulated an explosion of CGE-based research beginning in the early 1980s. Decaluw'e and Martens have surveyed 73 examples of CGEs applied in 26 developing countries. Pereira has also surveyed applications of CGEs to tax policy analysis.

Dervis, de Melo and Robinson developed a "standard" CGE methodology, and described several applications by World Bank researchers in developing countries. Devarajan and Lewis documented a CGE model of the Cameroon economy which became widely adapted to different countries during the 1980s. An unusually detailed description of the USDA\ERS CGE is provided by Robinson, Kilkenny and Hanson. This model was adapted from the Cameroon CGE and used to analyze the impact of alternative trade regimes (under GATT and NAFTA) on U.S. agricultural sectors.

In another important contribution, Shoven and Whalley (1984) described 18 applications of CGEs to tax and trade policy issues. This work was later expanded into one of the most accessible sources currently available on CGE methodology and application (see Shoven and Whalley (1992)).

Notwithstanding the proliferation of national and international CGE analysis, application of CGE methodology to regional (subnational) issues has been limited. A major constraint is the availability of a consistent data set from which to fashion the base year set of accounts. At the national level this problem is minimized through access to NIPA and IO accounts and consumer expenditure surveys. At the regional level the availability of such accounts is problematic.

Recent developments are lifting this constraint. Derivative regional accounts have been used to construct CGEs for Oklahoma (Koh; Koh, Schreiner and Shin), and Southern California (Robinson, Subramanian and Geoghegan). In both cases the authors used data generated by IMPLAN (Alward et al.). Using IMPLAN it is possible to construct internally consistent current economic flow accounts for any region (defined as an aggregation of counties) in the U.S.

Defining Tax Incidence

Mieszkowski (1969) described the pervasive influence of taxes on economic behavior:

> Associated with tax policy are a number of interrelated effects. Taxes have a direct impact on the level of effective demand and employment. Taxes affect work incentives, the amount of saving and the level and pattern of investment. Some taxes distort the allocation of resources and lead to inefficiencies. Finally, the level and structure of taxes determines the level of disposable

income, and the distribution of after-tax income among different groups.

How the actual burden of taxation is distributed among economic agents has long been a subject of debate. Seligman noted that informed discussion regarding the problem of tax incidence had been distinguished by a "simplicity of ignorance". "Yet", he continued, "no topic in public finance is more important; for, in every system of taxation, the cardinal point is its influence on the community."

Unfortunately the tax policy debate has been hindered by some confusion regarding terminology. For example, the term "tax incidence" has been applied to the act of remitting a tax (direct incidence) as well as to the final distribution of impact after any tax "shifting" has occurred (final incidence). Likewise, the term "tax burden" has been ascribed to the share of total economic cost of a tax absorbed by given sector, or, more specifically, to only that portion of economic cost in excess of tax revenues raised.

To avoid confusion, the terms "tax burden" and "tax incidence" will both be used here to refer to the final distribution of economic costs resulting from a change in tax and/or budget policy. The direct payment of a tax will be referred to as the "initial impact" or "assessment". The terms "excess burden" and "deadweight loss" will be used interchangeably to indicate any reduction in economic efficiency resulting from tax-induced interference with the attainment of private, marginal efficiency conditions.

It is generally simple to ascertain responsibility for paying the direct assessment of a tax. Business owners pay property and excise taxes. Personal income and social security taxes are withheld from payrolls. It is more difficult, however, to discern whether or to what extent the actual burden of a tax is shifted onto other economic agents.

Consider, for example, a commodity excise tax under which producers pay the government a certain amount per unit of output. While producers might simply absorb the full amount of the tax by reducing net profits, economic theory suggests that other responses are perhaps more likely. The tax could be shifted forward as higher consumer prices. Alternatively, the burden might be shifted backward, reducing payments to one or more factors of production. Subsequent effects might then induce consumers to purchase less expensive substitutes for the taxed good, and/or reduce total consumption expenditures as reduced factor incomes generate lower household incomes.

After all adjustments have been made, the final distribution of burden borne by all economic agents defines the incidence of the tax, irrespective of who actually paid the initial assessment. Tax incidence is determined by a combination of two influences, i.e. effects on:

1. sources of income, i.e. the sum of any changes in factor incomes received, and

2. uses of income, i.e. changes in consumption expenditures.

The total impact of a tax on a group of individuals is the sum of costs borne by them in their roles both as producers and as consumers (Pechman). A priori there is no reason to expect one effect to be more important than the other (Mieszkowski (1967)).

Boadway and Wildasin offer a succinct explanation of tax incidence analysis. "The study of tax incidence attempts to determine who in the economy bears the burden of taxation. That is, who in the private sector sacrifices the resources transferred to the public sector by taxation, and how is the distribution of this sacrifice different under one tax as opposed to another." This statement suggests two avenues of tax incidence analysis:

1. balanced budget (or expenditure) incidence, the more general case, where the effects of a tax change are studied in combination with any changes in government spending, and

2. differential (or revenue neutral) incidence, in which a given tax is replaced with another yielding exactly the same revenue (so government spending doesn't change).

Differential incidence avoids the difficult problem of comparing welfare under different levels of government activity. Balanced budget incidence allows analysis of the total (tax and spending) impact of alternative government expenditure programs.

Analysis of Tax Incidence

There are two classes of methodologies used to estimate the distribution of tax impacts: Partial Equilibrium and General Equilibrium.

Partial Equilibrium Methods

Partial equilibrium treatments are confined to analysis of price and quantity adjustments in the market which is directly taxed. Origin of the partial equilibrium method is widely attributed to Marshall. Its essence is summarized in Dalton's Law: "The burden of a tax is shared by suppliers and demanders according to the price elasticities of supply and demand, with the buyer's share the larger the less elastic is demand and the more elastic is supply" (Dalton).

The partial equilibrium framework marks a significant advance in the analysis of economic phenomena. However its focus on a single market necessarily assumes any price effects in other markets to be insignificant. The validity of this assumption generally cannot be determined a priori. For example, consider a tax imposed on labor inputs to production. The tax creates a "price wedge" between the wage rate paid by producers and that received by laborers. Labor scarcity will increase as workers reassess their labor-leisure allocation in light of the tax, contributing to a reduction in the relative cost of other, relatively abundant, factors. The magnitude of this effect depends on the cost-share of the taxed factor in the production process, and on the degree to which factor substitution is possible.

While neoclassical supply and demand schedules implicitly incorporate such indirect influences, partial equilibrium analysis cannot explicitly account for changes in other factor and commodity prices. This is, however, such an important determinant of tax incidence that many attempts have been made to extend the partial equilibrium framework by incorporating side calculations based on extraneous estimates of tax burden shares and price transmission effects between markets. Significant examples of this extended partial equilibrium tax incidence methodology include applications by Phares (1973, 1980), Browning and Johnson, and Pechman.

Analysts have long recognized that tax impacts are transmitted through the economy via *relative* price changes. According to Pechman:

> The incidence of a tax depends on relative prices and relative factor incomes. Through its monetary and fiscal policies the government can cause the general price level to rise, fall, or remain unchanged when a tax is increased or a new tax is imposed. Consequently the absolute price level is not relevant to incidence analysis. What is relevant is the effect of a tax on the distribution of real incomes that are available for private use; and this depends on the changes in relative product and factor prices and not on changes in absolute prices.

Changes in relative factor and commodity prices cause producers and consumers to reallocate resources, incomes and expenditures. The importance of relative prices to tax incidence analysis suggests that Walrasian, general equilibrium methods might be particularly applicable.

General Equilibrium Methods

Musgrave introduced a modern general equilibrium theory of tax incidence, defining it as a comparison of "...the equilibrium which prevails prior to the introduction of a budgetary change (e.g. substitution of tax x for tax y) with that which prevails after all adjustments to this change have been completed." Musgrave observed that the direction of the initial adjustment is not important, since (as in the case of an excise tax) incidence is determined by the prevailing elasticities of supply and demand in <u>all</u> relevant commodity and factor markets, not just the taxed one. This suggests a generalization of Dalton's Law to a general equilibrium context.

Wells described the extensive web of interrelated effects which determines tax incidence using the example of a commodity excise tax, beginning with effects on the *uses of income*:

> ...total spending on the output of any given industry will decrease as that industry is taxed. The output of the taxed industry will decrease and its price will increase. Demand for the complements of the taxed commodity will decrease and both the price and the output of these commodities will fall. Resources will be released by the taxed industry and industries producing commodities complementary to the taxed commodity. Increased spending will be directed toward the output of the industries producing substitutes for the taxed commodity and to the industries producing commodities complementary to the substitute commodities of the taxed commodity. Additional resources will be demanded by these expanding industries. If the economy is to respond to the change in spending with a change in the composition of output, it will be necessary for relative factor prices to change...,

and including effects of the tax on sources of *income*:

> In order to know just which factors will be made worse off and which better off, it would be necessary to know: (a) the industries away from which consumers direct their spending, and the industries toward which they direct their spending, as the output of one industry is taxed; (b) the direction of spending of the additional tax receipts by the taxing agency; and (c) the proportions in which the expanding industries and the contracting industries employ the various factors of production. The excise tax will also exert a burden on the consumers of the taxed commodity, the substitutes of the taxed commodity, and the complements of those substitutes; and the burden will be heaviest for those consumers for whom there exist few or no close substitutes for the taxed commodity. The excise tax will benefit not only those owners of factors of which the prices have increased, but also the consumers of the complements of the taxed commodity.

A theoretical breakthrough in the implementation of general equilibrium analytical methods was provided by Harberger. He succeeded in expressing the existing thinking on general equilibrium tax incidence in a fairly general mathematical model. Based on a specification developed for trade policy analysis, "the Harberger model" incorporated two industry sectors, corporate and non-corporate, which produce distinct commodities and pay factor rentals; a homogeneous household sector which receives factor rents and consumes commodities; and a government sector which collects taxes and spends tax revenues so as to exactly offset foregone household consumption (at pre-tax relative prices). The model is expressed in reduced form as a system of three linear equations which is solved for percentage change in prices and quantities as functions of elasticities, factor shares and tax rates.

Harberger analyzed the incidence of the corporate income tax on the utilization of capital services by the corporate sector in the U.S. Incidence is measured as percentage change in the gross price of capital. Under what he considers a reasonable set of assumptions (including fixed capital supply which is mobile between sectors), Harberger concludes "..that capital probably bears close to the full burden of the tax", although the burden is spread among both (corporate and non-corporate) uses of capital.

Subsequent work extended the basic Harberger framework to analyze the incidence of other taxes under different assumptions. Applications include investigation of: proportional income taxes, general sales taxes, value-added taxes, partial commodity (i.e. excise) taxes, and partial factor taxes. Key modeling assumptions which have been varied by different authors include: factor substitution elasticities, factor supply elasticity, intersectoral factor mobility, sectoral disaggregation, and relative factor shares [see Mieszkowski (1967, 1969); Hoffman, Krauss and Johnson; McClure and Thirsk; and McClure (1974, 1975)].

By the late 1960s, researchers had expressed dissatisfaction with the limitations of Harberger-type analysis. Among the chief complaints were: extreme sectoral aggregation, assumption of homogeneous household sector, unrealistic treatment of government, inability to analyze balanced budget incidence, necessity of using a "tax free" baseline scenario, and omission of a foreign sector. The model was also limited in its applicability for analyzing large tax changes because of the necessary interpretation of model variables as differential (i.e. infinitesimal) changes.

CGE Analysis of Tax Incidence

Another major breakthrough in applied tax incidence analysis was demonstrated by Shoven and Whalley (1972). They utilized a numeric solution algorithm which allowed more detailed treatment of household and foreign sectors; greater disaggregation of producer sectors; and a more complex and realistic treatment of taxes and government spending. They are generally credited with introducing the use of computable general equilibrium models for analysis of tax and budget policy.

The authors point out that Harberger's linearized functional format limits the generality of his results. Also his commodity demand functions can not be derived from utility maximization and thus are not entirely consistent with modern economic theory. Shoven and Whalley's demand specification uses the linear expenditure system (LES) which is derived from a Stone-Geary utility function (Phlips). Another improvement is their ability to translate impacts on the functional income distribution into changes in the household (i.e. size) distribution of income.

> Harberger looks at incidence as the effect of the distortion on the functional distribution of income. While this is of interest, in the U.S. economy capitalists work, laborers save, and both to a limited extent exercise a work leisure choice. Thus, at the least the incidence of both the taxation and the expenditure side on the personal distribution would be an additional interesting aspect of the distortion [Shoven and Whalley(1972)].

Shoven and Whalley accomplished this by assuming that factor incomes are distributed to the two household income groups according to fixed initial factor endowments.

Shoven and Whalley reproduced Harberger's results given equivalent assumptions (i.e. fixed but intersectorally mobile capital stock), however a wide range of results were demonstrated by varying this and other assumptions. They concluded, "It would seem that in those areas where policy judgments are to be made on the basis of calculations of distortionary impacts, major attention should be focused upon analyzing the effects with general equilibrium computation techniques such as presented here."

Keller expanded on work by Shoven and Whalley and Johansen in constructing his CGE model of the Netherlands. In so doing he emphasized the importance of considering tax incidence in terms of impacts on households rather than on the functional income distribution:

> ...the partial nature of both concepts of price burden and tax shifting may give rise to some confusion when not properly interpreted. In contrast, the burden on an individual ... is invariant with respect to the choice of the numeraire and on whom the tax is imposed.

Keller analyzed the impact of various hypothetical taxes, including specific sales taxes, factor taxes and household income taxes. Estimates of tax incidence were generally small, he concluded, due to the openness of the Dutch economy and the very similar factor intensities of his four, aggregate production sectors (food, durables, services, capital goods). In testing the specification of his model, Keller concluded that his results were not systematically sensitive to varying exogenous elasticities of substitution on production and consumption functions.

Hong developed a CGE model of the Korean economy with thirteen industrial sectors and four socio-economic household groups to perform differential tax incidence analyses under two hypothetical scenarios: 1) replacing a complex of indirect taxes with a uniform value added tax (VAT); and 2) replacing all capital income taxes with proportional, lump-sum taxes on personal income. Hong used a linearized version of his model which he solved using a linear programming algorithm. His results showed a modest increase in economic efficiency and mildly regressive incidence under VAT reform; and significant improvement in economic efficiency and progressive incidence under capital income tax reform.

A comprehensive description of a CGE model of the UK is provided by Piggott and Whalley. Their model is significant for its large dimensions: 33 producer goods and industries and 100 household categories. In examining the impact of distortions in the 1973 UK tax structure, the authors estimated that replacing all taxes with an equal revenue, single-rate sales tax would have improved annual welfare by 6% to 9% of net domestic product. This policy would, however, reduce incomes of the poorest households by 20% while increasing the top decile's income by approximately the same percentage.

Ballard, Shoven, Fullerton and Whalley (BSFW) produced probably the most comprehensive evaluation of U.S. tax policy to date. They examined several categories of tax instruments, including capital, payroll and property taxes; personal income taxes; sales and excise taxes; charges on motor vehicles and other tax and nontax payments by industries. Their CGE model consists of nineteen aggregate industries producing fifteen categories of consumer goods which are purchased by twelve household income groups. All taxes are transformed into ad valorem equivalents for modeling purposes. In addition to the standard static analysis, BSFW approximated a dynamic analysis using an endogenous savings-investment relationship to link a sequence of single-period equilibria through endogenous intertemporal adjustments in capital stocks.

Hertel and Tsigas incorporated Keller's CGE methodology and BSFW's tax structure to examine the incidence of the preferential tax treatment of the U.S. farm sector during the 1970s. Hertel and Tsigas conducted counterfactual experiments in which taxes on capital, labor, sales and production were equalized across all sectors of the economy. They conclude that preferential tax treatment of agriculture "...plays a major role in determining the size and composition of the U.S. farm and food system."

Boyd and Newman adapted BSFW's approach to analyze the effect of the Tax Reform Act of 1986 on land-using sectors in the U.S. They compared results of their general equilibrium simulation with partial equilibrium analysis of the same problem. They conclude that tax reform affects land-using sectors more negatively than other economic sectors, but that these effects appear much smaller under general equilibrium analysis. They emphasize that by directly linking supply side and demand side effects through incorporation of endogenous prices, finite resources and a consistent accounting framework, CGE provides a superior tool for analysis of tax policy than partial equilibrium treatments.

Jones and Whalley used a multiregional CGE model of Canada to analyze differential regional effects of federal trade and agricultural policies, federal transfers to regional government, and federal and provincial taxes. They contrasted their results with analysis of "regional balance sheets", which compare differences in taxes collected and direct expenditures made in the various regions of the Canadian economy. Jones and Whalley criticized reliance on regional balance sheets due to the tendency to...:

> ...treat regional effects of policies as if net benefits sum to zero. They [balance sheets] only capture the cash component of transactions between regions rather than wider impacts on regional welfare. They ignore indirect effects, such as changes in regions' terms-of-trade. And, the reference point for assessing regional gains or losses is taken to be a situation in which policies are absent, rather than the next best alternative for the region (such as leaving the Federation).

Policy changes which improve economic efficiency are demonstrated to produce net positive rather than zero welfare gains for the national economy. Losing regions' losses are smaller, and gaining regions' gains are greater than is shown using regional balance sheets. The authors also performed sensitivity analysis with respect to exogenous elasticity estimates, finding that results are not particularly sensitive to varying specifications of trade elasticities. Results are more sensitive to interregional labor migration elasticities.

Morgan, Mutti and Partridge used a multiregional CGE model to examine the influence of differential federal and regional taxes on the distribution of economic activity in the U.S. Although government policy is not able to influence many of the factors which influence business location, there is mixed evidence that state and local tax policies do influence geographic location of economic activity (McGuire). When Morgan, Mutti and Partridge simulated unilateral removal of state and local taxes, they found economic growth in that region occurred mostly at the expense of economic activity in the other regions. When all federal and regional taxes were removed in all regions, the authors found a small increase in total output and a significant reallocation of economic activity away from regions enjoying low taxes and large federal transfers (Southeast, Southwest), toward high tax, low transfer regions (New England-Mideast and Great Lakes).

Rickman developed a more detailed focus on the impacts of business assistance programs in a specific region. He used a CGE model to try to reconcile the optimistic assessments of the benefits of granting tax breaks and subsidies found using IO models, with econometric studies' generally indifferent assessment of business assistance programs. Rickman's model is composed of two regions, the BEA's Plains-Rocky Mountain Regions plus Alaska (PLRM), and the rest of the country. He examined the impact of eliminating all corporate income taxes in the PLRM region using different model specifications: ranging from one with fixed factor supplies and endogenous prices (NM) to one with elastic factor supplies and fixed factor prices (KM). He found that results using the former specification (NM) came much closer to approximating the results of econometric appraisals of regional development programs.

Comparing the interregional effects of tax policies is also central to work on "tax exportation" described by Mutti and Morgan. Tax exportation refers to the tendency for the burden of a regional tax to be borne by residents of other regions. Examples include the assessment of high local excise taxes on industries which export a large proportion of output (direct tax exportation); and the reduction in federal income tax liability of state residents by the amount of state and local taxes paid (indirect tax exportation).

Applied, numerical CGE modeling has been shown to be useful for analyzing a wide range of economic policy impacts under a variety of assumptions. There has been a tendency, however, to overestimate the benefits of the technique. There is the problem of constructing a balanced, consistent data set from disparate sources, although this is not necessarily unique to CGE modeling. Relatively more problematic is the difficulty of specifying factor supply, substitution and external trade elasticities. There has not been much empirical work at the regional level to guide these choices.

In assessing the CGE methodology, BSFW offer the following caveat on the interpretation of simulation results.

> We emphasize that these results are not specific forecasts of the U.S. economy under alternative policy regimes. Rather, the model should be viewed as providing a numerical approach to economic theory and policy. We use the numerical equilibrium model to provide the same kind of economic insight that a theoretical model would provide for a simpler problem that could be solved analytically. We look at tax changes with a strong ceteris paribus assumption, so we do not consider any of the myriad possible nontax changes that can affect the actual development of the economy.

It is important to remember this lesson when interpreting results or drawing policy conclusions from economic modeling efforts.

CHAPTER 2

THE OREGON CGE MODEL

A CGE is distinguished from a linear SAM model by more general specifications of production, consumption, absorption and transformation constraints; and the inclusion of prices which reflect the economic scarcity of all commodities and factors in the model. Compared with fixed-price models, CGE methodology allows greater flexibility in the specification of variables and behavioral relationships.

Figure 1 traces the basic steps comprising a CGE modeling effort. First, data are collected, organized and reconciled to construct a benchmark equilibrium data set. This step is often the most difficult and time consuming. Next, behavioral and accounting relationships are specified, and the model parameters are calibrated given the benchmark data. If the calibrated model succeeds in reproducing the benchmark data, then the model has probably been correctly specified. Next, a policy change scenario is introduced, and a counterfactual equilibrium representing the situation under the new policy is calculated. Policy appraisal or incidence analysis is completed by comparing the counterfactual equilibrium quantities and prices with the benchmark scenario.

Estimates of base year economic flows were organized in a SAM format with row and column entries corresponding to revenues and expenditures, respectively, of regional economic accounts (Table 1). The commodity and industry accounts have been aggregated and categorized as either "goods" or "services" according to the primary output of each sector. In a SAM, row and column sums must equal. Control totals and free variables are used to balance each account and to define linkages with other accounts. The tabular structure of the SAM suggests a system of equations which can be solved for endogenous variables given a set of exogenous variables and parameters.

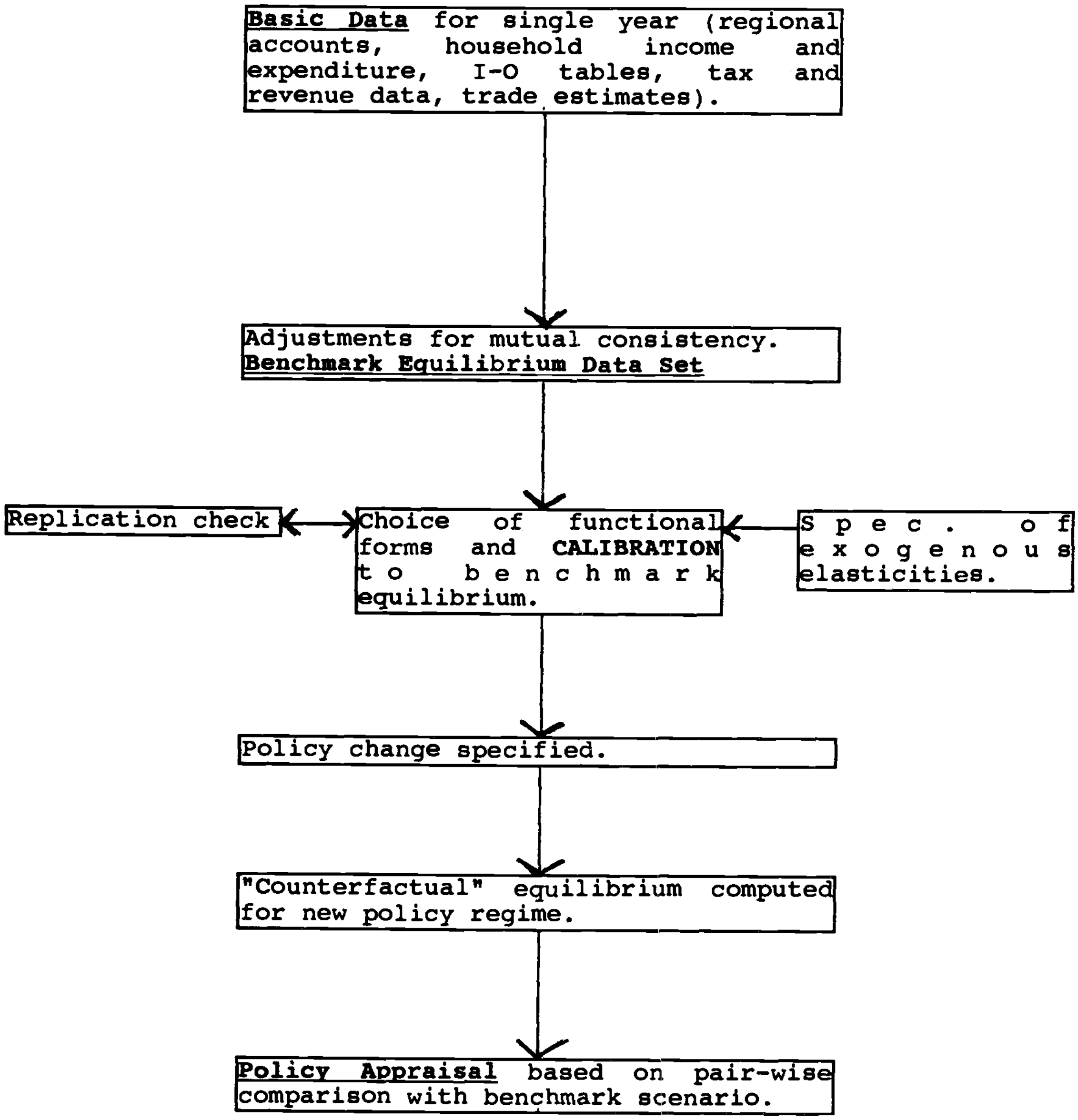

Figure 1. FLOW CHART OF GENERAL CGE MODELING PROCEDURES

(Adapted from Shoven and Whalley (1984) Fig. 1, p.1019)

Table 1. 1990 OREGON AGGREGATE SOCIAL ACCOUNTING MATRIX.

($MM 1990)

	LABOR	PROP	CAP	G-COM	S-COM	G-IND	S-IND	ENTER	SAV-INV
LABOR						10054	23542		
PROP						1827	2877		
CAPITAL						2516	6191		
GOODS COM						18662	6154		5285
SERV COM						8650	11237		683
GOODS IND				19942					
SERV IND					43181				
ENTERPRISE			2177						
SAV-INV									
HH LOW	4744	47						1161	
HH MED	12536	2070						4108	
HH HI	10655	2587						2947	
FED	4828		485	653	27	128	621		
S/L NONED	348		146	286	1014	357	1185		
S/L EDU						201	665		
CURRACC	485		2172	23369	12184	64	8		
FINANCE			3727					714	
TOTAL	33595	4704	8707	44249	56407	42460	52480	8930	5968

+	HHLOW	HHMED	HHHI	FED	NONED	EDU	CURRAC	FINANCE	TOTAL
LABOR									33595
PROP									4704
CAPITAL									8707
GOODS COM	2064	5015	2646	610	2242	1571			44249
SERV COM	6353	14817	7499	1381	3980	1808			56407
GOODS IND							22518		42460
SERV IND							9299		52480
ENTERPRISE								6753	8930
SAV-INV	96	491	2020					3361	5968
HH LOW				2644	607				9203
HH MED				2824	649				22186
HH HI				541	124				16854
FED	288	883	2703					-616	10000
S/L NONED	239	591	1405	1640				1744	8954
S/L EDU	96	208	496	360	1353				3379
CURRACC	67	182	86						38618
FINANCE							6800		11242
TOTAL	9203	22186	16854	10000	8954	3379	38618	11242	

Structure of the CGE

Figure 2 traces the linkages between components of the CGE (A list of variables, parameters and equations in the Oregon CGE model is provided in appendix A). First, value is added to inputs of labor, proprietors' services, and capital via linearly homogeneous Cobb-Douglas production functions and combined with intermediate inputs to produce output for each sector (X). Each unit of X is either sold regionally (XXD) or exported (E) via a constant elasticity transformation function (CET). Exports supply world markets, facing perfectly elastic demand conditions (i.e. fixed world commodity prices).

Regionally produced goods are absorbed along with competitive imports (M) via a constant elasticity of substitution (CES) Armington function to form a composite absorption good for each commodity (Q). This composite mix of imports and regional goods supplies intermediate demand (ND), final demand for consumer goods (C), investment needs (IT) and government purchases (G).

In all scenarios, federal government expenditure is exogenous. Spending on education and/or other programs by state and local government is either exogenous or endogenous, depending on the scenario. In the differential (revenue neutral) scenarios, expenditures by both state and local government units are fixed in real terms. For balanced budget analysis, spending by one of the two state and local government sectors is fixed, depending on the scenario. If spending on state and local education programs is fixed, then expenditures on non-education programs adjust endogenously to changes in tax revenues. If spending on non-education programs is fixed, then education expenditures respond directly to changes in tax revenues. The adjustments are accommodated by an intergovernmental financial variable which transfers an amount of funds just sufficient to finance expenditures by the exogenous account. Remaining revenues are then utilized by the endogenous account.

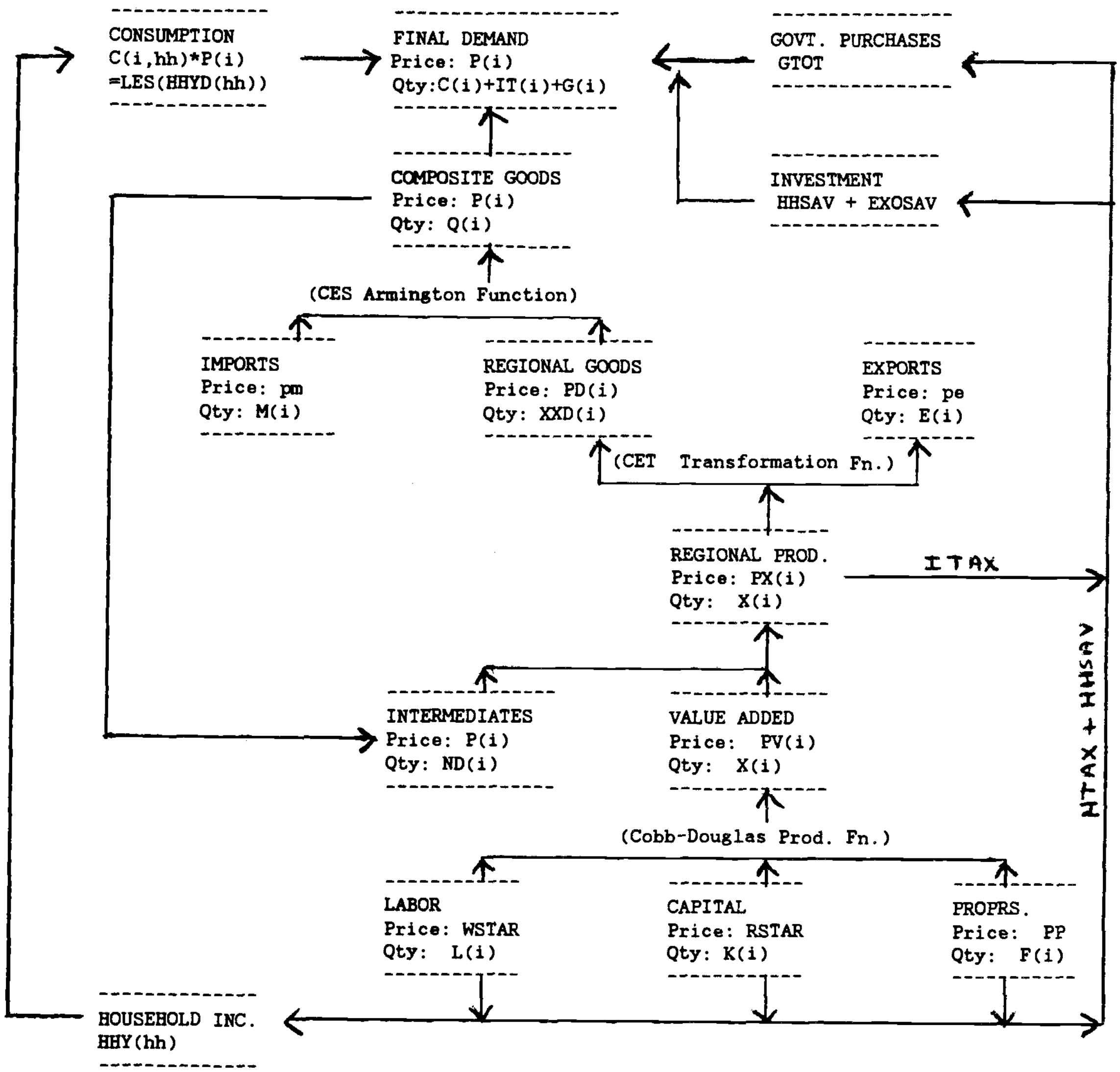

Figure 2. SCHEMATIC OF OREGON CGE MODEL

Changes in spending by each of three household income classes are driven by endogenous factor incomes. Investment is either endogenous or exogenous depending upon model closure. These and other components of the model are discussed in greater detail below.

Production

Output is determined by linearly homogeneous Cobb-Douglas production functions using inputs of labor, proprietors' services, and capital (1).

$$X_i = av_i\left(L_i^{lshare_i} \times F_i^{fshare_i} \times K_i^{kshare_i}\right); i=1...n \tag{1}$$

First order conditions (focs) for profit maximization (with endogenous output prices) determine input demand for each sector (2,3,4)

$$L_i \times W^* = PV_i \times lshare_i \times X_i; i=1...n \tag{2}$$

$$F_i \times PP = PV_i \times fshare_i \times X_i; i=1...n \tag{3}$$

$$K_i \times R^* = PV_i \times kshare_i \times X_i; i=1...n \tag{4}$$

Factor market equilibrium is achieved by equating available supply with derived demand for labor (5), proprietors (6) and capital (7).

$$LTOT = \sum_{i=1}^{n} L_i \tag{5}$$

$$FTOT = \sum_{i=1}^{n} F_i \tag{6}$$

$$KTOT = \sum_{i=1}^{n} K_i \tag{7}$$

In contrast with traditional regional analysis where all prices are fixed and factors migrate freely between regions and between sectors, in the Oregon CGE model, factor market equilibrium is restored by endogenous adjustment of either factor supplies or gross factor return rates. Under one type of closure, all factor supplies are fixed at the regional level. Endogenous factor prices adjust to restore equilibrium in the factor markets. Under an alternative closure, labor supply is free to adjust endogenously to a fixed wage level. Supplies of other factors (proprietors, capital) are fixed (with endogenous prices).

The assumption of perfect intersectoral mobility for all factors is generally maintained in the Oregon CGE model. Under this assumption, each unit of homogeneous factor will seek its highest available return, thus allowing the use of a single, economy-wide rate of return for each factor. This is evident in equations 2,3,and 4 where the gross factor return variables, W^*, PP and R^*, do not carry industry subscripts. For comparison, an alternative specification is also examined. Under this treatment, capital endowments are assumed to be fixed intersectorally as well as within the region. Thus capital rental rates are allowed to vary between sectors, while single rates of return are maintained for labor and proprietors. In this case, R^* and R (capital's rate of return net of factor taxes) would carry industry subscripts (i.e. R^*_i, and R_i). The assumption of intersectorally fixed capital provides estimates of fairly short term (1-2 years) economic adjustment. The assumption of intersectorally mobile capital allows capital reallocation in response to emerging economic opportunities. Estimates derived using this assumption depict a somewhat longer term picture.

Net factor return rates are calculated by subtracting labor (8) and capital (9) taxes from total factor returns. For proprietors, net factor returns are assumed to equal gross factor returns.

$$W=W^*(1-\sum_{g=1}^{3} sstaxr_g) \qquad (8)$$

$$R=R^*(1-\sum_{g=1}^{3} corptaxr_g-depr) \qquad (9)$$

Interindustry demand for commodities is calculated as a fixed proportion of industry output (10).

$$ND_i = \sum_{j=1}^{n} a_{i,j} \times X_j ; i=1\ldots n \tag{10}$$

Trade

Output is allocated between export and regional sales via a constant elasticity of transformation (CET) function for each sector (11). In effect each sector is modeled as a two-product firm, producing one product for export and another for the local market. Revenue maximization determines the relative proportions of output supplied to satisfy exports and regional demand (12).

$$X_i = at_i \left(\gamma_i E_i^{\frac{\tau_i+1}{\tau_i}} + (1-\gamma_i) XXD_i^{\frac{\tau_i+1}{\tau_i}} \right)^{\frac{\tau_i}{\tau_i+1}} ; i=1\ldots n \tag{11}$$

$$\frac{E_i}{XXD_i} = \left(\frac{pe \times ER}{PD_i} \times \frac{1-\gamma_i}{\gamma_i} \right)^{\tau_i} ; i=1\ldots n \tag{12}$$

Constant elasticity of substitution (CES) "Armington functions" combine imported and regionally produced commodities, including sales by regional and federal government agencies, to produce composite commodities (13). Each composite represents total supply available to satisfy interindustry requirements, consumer purchases, and government and investment demand (14). Expenditure minimization determines the ratio of imports to regional commodities absorbed (15). This feature accommodates the phenomenon of crosshauling in which simultaneous imports and exports are observed in highly aggregated sectors (Shoven and Whalley 1984).

$$Q_i - \sum_{g=1}^{3} GS_{g,i} = ac_i \left(\delta_i M_i^{\frac{\sigma_i-1}{\sigma_i}} + (1-\delta_i) XXD_i^{\frac{\sigma_i-1}{\sigma_i}} \right)^{\frac{\sigma_i}{\sigma_i-1}} ; i=1\ldots n \tag{13}$$

$$Q_i = ND_i + \sum_{hh=1}^{3} C_{i,hh} + IT_i + \sum_{g=1}^{3} G_{i,g} ; i=1\ldots n \tag{14}$$

$$\frac{M_i}{XXD_i} = \left(\frac{PD_i}{pm \times ER} \times \frac{\delta_i}{1-\delta_i} \right)^{\sigma_i} ; i=1\ldots n \tag{15}$$

Price Determination

Given fixed import and export prices, expenditure functions (16) and revenue functions (17) (duals of the CES and CET functions, respectively) determine endogenous prices for total absorption, output, and regional production of each sector. Value added per unit of output is calculated by subtracting indirect taxes and payments for intermediate inputs from each sector's average regional producer price (18). Industry expenditures on "non-comparable imports" (i.e. imported commodities produced by industries for which no regional counterpart exists) are calculated as fixed proportions of industry output (19).

$$P_i \times Q_i = PD_i (XXD_i + \sum_{g=1}^{3} GS_{g,i}) + pm \times ER \times M_i ; i=1...n \tag{16}$$

$$PX_i \times X_i = PD_i \times XXD_i + pe \times ER \times E_i ; i=1...n \tag{17}$$

$$PV_i = PX_i \left(1 - \sum_{g=1}^{3} ibtaxr_{g,i} - ncimpir_i\right) - \sum_{j=1}^{n} a_{j,i} \times P_j ; i=1...n \tag{18}$$

$$pm \times ER \times INDIMP_i = ncimpir_i \times PX_i \times X_i ; i=1...n \tag{19}$$

A general equilibrium model embodies Walras' Law, hence all prices are relative to a numeraire. In a regional model the exchange rate, defined as the value of the regional unit of exchange in terms of world prices, is necessarily fixed. Hence here it has been designated numeraire and arbitrarily set equal to one.

Household Income

Income is allocated to factors (labor, proprietors and capital) based on equilibrium input quantities and factor prices. Factor incomes are mapped into institutional incomes, i.e. labor (20), proprietors (21), capital (22) and enterprises (23), net of payroll taxes, capital taxes, depreciation, enterprise savings, and adjustments for non-resident labor (24) and capital (25) services used by regional industries.

$$LABY_i=W\times L_i-RADJ_i;\, i=1\ldots n \tag{20}$$

$$PROPY=PP\times\sum_{i=1}^{n}F_i \tag{21}$$

$$CAPY=R\times\sum_{i=1}^{n}K_i-CADJ \tag{22}$$

$$ENTY=(1-retearnr)\times(CAPY+exoincome) \tag{23}$$

$$RADJ_i=resadjr\times W\times L_i;\, i=1\ldots n \tag{24}$$

$$CADJ=capadjr\times R\times\sum_{i=1}^{n}K_i \tag{25}$$

Income is distributed to the three household income categories (low, medium and high) according to fixed-share payments of labor and proprietors' income by industries, fixed institutional shares of enterprise income (i.e. net dividends, interest and rent) and exogenous government and private transfers (26). Disposable income is computed net of household taxes (27).

$$HHY_{hh}=\sum_{i=1}^{n}WMAT_{hh,i}\times LABY_i+propyr_{hh}\times PROPY+entdis_{hh}\times ENTY+\sum_{g=1}^{3}TRANSo_{g,hh};\, hh=1\ldots 3 \tag{26}$$

$$HHYD_{hh}=HHY_{hh}-\sum_{g=1}^{3}HTAX_{g,hh};\, hh=1\ldots 3 \tag{27}$$

Government Revenue

Government revenue is collected via payroll taxes (28), capital taxes (29) and indirect taxes (30), composed of property (31) and excise taxes (32), imposed on producers; household taxes (33), composed of property (34) and income taxes (35,36) collected from households; and sales of goods and services produced by public industry and enterprises (37). Under the Oregon tax code, exportation of residential property taxes is somewhat offset by residents' ability to deduct a portion of their federal income tax liability from state taxable income. Hence, the model includes mechanisms to deduct local residential property taxes from income which is taxable by the federal government (38), and also to subtract federal income tax payments from income which is taxable by the state (39). State-taxable household income is thus defined as total household income minus a deduction for a portion of federal income tax liability (although high income households are assumed to have already reached their deductibility limit of $3,000).

Oregon has no general sales tax. Other regional government revenues (lottery profits, federal grants, investment income, net interest, and other taxes) are treated as exogenous inflows to the state and local government accounts.

$$STAX_g = sstaxr_g \times W^* \times \sum_{i=1}^{n} L_i ; g=1...3 \quad (28)$$

$$CTAX_g = corptaxr_g \times R^* \times \sum_{i=1}^{n} K_i ; g=1...3 \quad (29)$$

$$ITAX_{g,i} = BUTAX_{g,i} + EXCTAX_{g,i} ; g=1...3, i=1...n \quad (30)$$

$$BUTAX_{g,i} = bustaxr_{g,i} \times BUSSo_i ; g=1...3, i=1...n \quad (31)$$

$$EXCTAX_{g,i} = extaxr_{g,i} \times X_i ; g=1...3, i=1...n \quad (32)$$

$$HTAX_{g,hh} = PROTAX_{g,hh} + INCTAXX_{g,hh} ; g=1...3, hh=1...3 \quad (33)$$

$$PROTAX_{g,hh} = proptaxr_g \times HHSSo_{hh} ; g=1...3, hh=1...3 \quad (34)$$

$$INCTAXX_{fed,hh} = inctaxr_{fed,hh} \times FEDINC_{hh} ; g=fed, hh=1...3 \quad (35)$$

$$INCTAXX_{ned,hh} = inctaxr_{ned,hh} \times NEDINC_{hh} ; g=ned, hh=1...3 \quad (36)$$

$$GS_{g,i} = govsalesr_{g,i} \times Q_i ; g=1...3, i=1...n \quad (37)$$

$$FEDINC_{hh}=HHY_{hh}-\sum_{g=1}^{3}PROTAX_{g,hh};hh=1...3 \quad (38)$$

$$NEDINC_{hh}=HHY_{hh}-INCTAXX_{fed,hh};g=fed,hh=low,med \quad (39)$$

Consumer Expenditure

Consumer expenditure is modeled as a function of commodity prices and fixed shares of household disposable income according to a linear expenditure system (40). Minimum subsistence expenditures by household sectors are assumed to be zero. In the absence of minimum subsistence expenditures, the LES can be derived from maximization of a Cobb-Douglas utility function subject to a budget constraint. Consequently there are no cross price or income effects and all goods are substitutes in consumption. The inclusion of three separate household income groups, and extremely aggregated commodity expenditure categories in the model probably somewhat mitigate the effect of using such a restrictive specification of consumer behavior. More flexible demand specifications, for example almost ideal demand systems (AIDS), are reportedly being examined for use in an updated USDA/ERS CGE.

$$P_i \times C_{i,hh}=cshare_{i,hh} \times HHYD_{hh};i=1...n,hh=1...3 \quad (40)$$

Government Expenditure

Commodity purchases by the federal government and by education and non-education functions of state and local government are determined as fixed shares of total revenues, net of any transfers to households or other government accounts (41). Modeled in this way, allocation of public sector expenditures can be derived from maximization of Leontief benefit functions subject to a revenue constraint. Each of the three government entities is assumed to provide a public "good" or function which contributes to well-being in the region.

$$G_{i,g}=gdr_{i,g} \times GTOT_g;i=1...n,g=1...3 \quad (41)$$

This specification assumes that preferences for public goods are separable from those for private goods. This implies that preferences for public expenditures are identical across households, and that marginal rates of substitution between private goods are unaffected by the level of government expenditures or by the consumption of other household sectors (and vice versa). A similar specification was used by Keller and is described in his Chapter 8. An example of a treatment which addresses demand for public goods in a somewhat more general manner is provided by Lee.

Implementing each of the three basic analysis scenarios required a different configuration of the relationship between the government sectors. One treatment was used to implement a differential incidence (i.e. revenue neutral) analysis, while different configurations were used for each of the two balanced budget scenarios. In all cases, federal government expenditures remained fixed in real terms.

For the balanced budget treatments, spending by one of the two state and local government accounts was fixed while expenditures by the remaining account adjusted endogenously to changes in tax revenues. The allocation of revenues between the two state and local government expenditure accounts was accommodated by a financial variable (see "EDTRANS", equation 46) which transfers an amount of funds just sufficient to finance the level of expenditures by the exogenous account. Any remaining revenues are then allocated to the endogenous account.

In the first of the two balanced budget treatments, expenditures for state and local education programs were fixed in real terms. With education spending fixed, an exogenous reduction in education-related revenues is accommodated by an endogenous transfer from the non-education function of state and local government. Expenditures for non-education programs were determined residually after education-related spending needs were met.

In the second balanced budget treatment, the relationship between the two state and local government accounts was reversed. Expenditures for non-education programs were now fixed in real terms. Reduced education revenues were thereby transmitted directly as reduced education-related expenditures.

For the differential incidence analysis, expenditures by both the education and non-education functions of state and local government were fixed in real terms. In response to the exogenous reduction in local property tax revenues, an endogenous tax instrument was allowed to adjust in order to recover tax revenues sufficient to maintain base levels of state and local government activity. The selected endogenous tax instrument was the average state income tax rate for high income category households. This instrument was selected for its ease of implementation and relevance to the ongoing tax policy debate in the state.

Macroeconomic Closure

The six major macro balances in the model are Savings=Investment, three government budget balances (federal, state and local non-education, state and local education), the balance of trade (exports minus imports), and payments=receipts in the external financial account.

The supply of regional savings (42) is composed of household savings (fixed proportions of disposable income), and a net financial inflow from outside the region (EXOSAV). Depreciation and retained earnings are modeled as payments to the external financial account rather than as endogenous additions to the supply of regional savings. While the latter is probably true at the national level, the former specification may be more consistent with the operation of capital markets in small regions.

$$EXOSAV=\sum_{i=1}^{n} P_i \times IT_i - \sum_{hh=1}^{3} sshare_{hh} \times HHYD_{hh} \tag{42}$$

Different specifications of investment behavior (43) were used depending on the type of model closure used (see MODEL CLOSURE). Under neoclassical closure, nominal investment demand adjusts according to LES shares of total savings supply, which consists of fixed external savings and income-driven household savings. Under Keynesian closure, nominal investment is fixed exogenously and external savings flows adjust to determine total supply of regional savings. LES investment shares are derived by the implied maximization of a Cobb-Douglas investment benefit function subject to an aggregate savings constraint.

$$P_i \times IT_i = invr_i \times ITOT; i=1...n \tag{43}$$

The regional federal government deficit is determined residually as the difference between federal government revenues and fixed real expenditures in the region (44). In the base year, there was a net surplus on the regional federal government account.

$$FEDFLO=\sum_{i=1}^{n}P_i\times G_{i,fed}+\sum_{hh=1}^{3}TRANSO_{fed,hh}+fedned+feded-STAX_{fed}-CTAX_{fed}$$
$$-\sum_{i=1}^{n}(GS_{fed,i}+ITAX_{fed,i})-\sum_{hh=1}^{3}HTAX_{fed,hh} \quad (44)$$

In the two state and local government accounts, non-education (45) and education (46) expenditures are balanced against endogenous tax revenues, fixed federal grants and a residual transfer between the two accounts. Commodity purchases by either one or both state and local government accounts are fixed at base year levels depending upon the mode of analysis and the particular scenario under investigation.

$$NEDFLO=\sum_{i=1}^{n}P_i\times G_{i,ned}+\sum_{hh=1}^{3}TRANSO_{ned,hh}+EDTRANS-STAX_{ned}-CTAX_{ned}-feded$$
$$-\sum_{i=1}^{n}(PD_i\times GS_{ned,i}+ITAX_{ned,i})-\sum_{hh=1}^{3}HTAX_{ned,hh} \quad (45)$$

$$EDTRANS=\sum_{i=1}^{n}P_i\times G_{i,ed}-\sum_{i=1}^{n}ITAX_{ed,i}-\sum_{hh=1}^{3}HTAX_{ed,hh}-feded \quad (46)$$

In the regional current account (47), the exchange rate is fixed. An accounting variable is used to balance net imports with a net financial inflow.

$$CADEF=\sum_{i=1}^{n}RADJ_i+CADJ+pm\times ER\times\left(\sum_{i=1}^{n}(M_i+INDIMP_i-E_i)+\sum_{hh=1}^{3}HHIMP_{hh}\right) \quad (47)$$

The external financial account is the institutional account which completes the model (48). Receipts to the account represent gross financial flows out of the region, including depreciation, retained earnings, a trade-balancing financial flow from the current account, and any federal government "surplus". Expenditures by the external financial account include regional inflows of dividends, interest and rent; "other" government revenues; and financial inflows to accommodate regional investment needs.

$$exoincome=depr\times\sum_{i=1}^{n}K_i\times R^{*}+retearnr\times(CAPY+exoincome)+CADEF$$
$$-FEDFLO-NEDFLO-EXOSAV \tag{48}$$

Since the model satisfies Walras' law, one of these six conditions is redundant given the other five. Consequently the equilibrium condition for the external financial account (48) has been omitted from the programming code (see MODEL CLOSURE, below).

Optimization of an objective function is used to trigger the GAMS non-linear equation solver. Since, in the Oregon CGE model, the number of equations equals the number of free variables, and given the convexity properties embodied in the selected functional forms, maximization (or minimization) of virtually any quantity in the model could serve this purpose. For convenience, maximization of total real household consumption was selected as the objective function (49).

$$\Omega=\sum_{i=1}^{n}\sum_{hh=1}^{3}C_{i,hh} \tag{49}$$

Calibration of Model Parameters

Calibration is a procedure whereby certain model parameters are calculated using baseline (i.e. equilibrium) SAM data. To calibrate the model, all prices are set equal to unity and the base year factor levels and SAM flows are substituted into the model as equilibrium values of model variables. The equations are then solved in reverse for the underlying parameterization (e.g. input-output coefficients, shift and share parameters for Cobb-Douglas, CES and CET functions, average tax rates, etc.). In this respect, calibration is analogous to maximum likelihood estimation with a single degree of freedom.

Estimates for elasticities of substitution and transformation for CES and CET functions, respectively, were selected based on reasonable guesses. Substitution (transformation) elasticities determine the demand for imports (supply of exports) relative to demand for (supply of) regional output. In lieu of better empirical information, a relatively elastic value of 1.5 was used for the more readily traded aggregate "goods" commodities, and a relatively inelastic estimate of 0.4 was used for "services" commodities.

aggregate "goods" commodities, and a relatively inelastic estimate of 0.4 was used for "services" commodities.

The logic underlying these selections is that while some interregional trade probably occurs for all commodity categories, services (including government services) tend to be relatively less transportable and generally more tailored to satisfy a regional clientele. This assumption could be challenged in the face of evidence that certain services (e.g. advertising, financial, consulting) are becoming increasingly more widely traded on global markets. However, relaxing the assumption that services are less tradable than goods (by setting the trade elasticities on CES and CET functions for all industries and commodities uniformly) did not seem to produce results which were systematically different than under the original assumption.

CES Armington functions provide imperfect substitutability between absorption of imports and regional goods. CET transformation functions approximate imperfect transformation substitutability between exports and regional goods. While these specifications serve to partially insulate the regional price system from exogenous changes in world commodity prices, they also embody strong assumptions. The trade functions imply that the equilibrium ratio of imports (exports) to regional use (regional supply) are functions of relative prices only, ignoring any income, output, or cross-price effects. The same is true for conditional factor demand relationships derived from the Cobb-Douglas production functions, and for the LES specification of consumer and investment demand.

Such functional forms greatly facilitate the calibration procedure. However the question of whether the implied restrictions on aggregate behavior (e.g. homogeneity, symmetry, homotheticity, etc.) are valid is an empirical question, although one which is not unique to applied general equilibrium modeling.

The computer program used to calibrate and solve the Oregon CGE model was adapted from GAMS code written by Dave Kraybill and Dee-Yu Pai (Kraybill and Pai). To check the parameterization, all quantities and prices are made endogenous and the model is solved in GAMS using nonlinear programming (NLP), maximizing household consumption. If the CGE has been properly calibrated, this solution will exactly reproduce the base year factor levels and SAM flows.

Model Closure

The tremendous flexibility of mathematical specifications for CGEs has given rise to another issue. That is, what are appropriate specifications for "closure" of regional models? (Rickman; Harrigan and McGregor). In economic modeling, closure refers to the specification of accounting and behavioral relationships between economic variables that determine how a model adjusts to economic shocks (Kraybill). In a Walrasian system, there are more equations determining the relationships between variables than there are free variables to be determined (Rattso). Different closures represent alternative theoretical treatments of this basic overdetermination of the Walrasian system. In general practice, one of the redundant conditions is dropped.

To illustrate the issue of closure, consider an economy in equilibrium. A necessary condition must be that:

$$Y \equiv E \qquad (50)$$

Where Y is total income and E is total expenditure. In a closed economy without government, this implies that:

$$Y \equiv C+I \qquad (51)$$

$$Y-C \equiv I \qquad (52)$$

$$S \equiv I \qquad (53)$$

Where C is consumption, I is investment and S is savings. In a closed economy, total income and total expenditures are in equilibrium when savings is equal to investment demand.

In an open economy with government, a more general specification of this relationship is:

$$Y=C+I+G+(E-M) \qquad (54)$$

$$Y=c\times Y+(s\times Y+F)+(t\times Y+D)+B \qquad (55)$$

$$Y(1-c-t)=s\times Y+F+D+B \qquad (56)$$

$$-B=F+D \qquad (57)$$

Where Y, C and I are as before; G is government spending; E is exports; M is imports; c, s and t are proportions of income allocated to consumption, savings and taxes, respectively (c+s+t=1); F is a net inflow of savings; D is the net government balance; and B is net regional exports. Equation (57) states that income and expenditures are in equilibrium when net imports are balanced by net inflows of external private savings and government funds. Since knowing any two of these variables automatically determines the third, they are not independent.

In application, this means that any one of the underlying conditions determining either the balance of trade (B), government deficit (D), extra-regional savings (F), or the relationship between these macro quantities (equation 57) can be dropped from the model code. In the Oregon CGE model, the equilibrium condition for the external financial account (equation 48), which is the applied counterpart of equation 57, above, has been dropped.

According to Kraybill, CGE closures can be categorized as one of three primary types: neoclassical, Keynesian or Johansen. Under neoclassical closure, endogenous factor prices adjust until factor supplies are fully utilized. Factor incomes determine regional savings, which, combined with net flows of external finance, determine endogenous investment. Keynesian closure assumes that, due to fixed or "sticky" factor prices, certain factor supplies are not fully utilized. Endogenous employment and external savings inflows adjust to furnish aggregate savings just adequate to meet exogenous investment requirements. Johansen closure assumes that consumption adjusts residually until savings and investment requirements are balanced, given fixed factor supplies.

Unfortunately, the mechanisms which determine regional financial flows and their effect on other macro variables are not well understood (Dow). With a fixed exchange rate, and all prices denominated in the same currency, the regional counterpart of a current account deficit has uncertain significance. In the absence of well-developed theory on the regional balance of payments issue, Kraybill has suggested that a Keynesian specification, with elastic supplies of some factors and endogenous financial flows, may be the more correct specification for modeling regional economies. Rickman, on the other hand, found that results under his neoclassical closure (NM) seemed to provide a better fit with empirical evidence of regional economic adjustment mechanisms.

The difference between these two interpretations may be simply a difference in definitions. Kraybill's Keynesian closure depends critically on the assumption of endogenous financial inflows to balance exogenous investment. Rickman's minimum requirement for Keynesian closure is the assumption of flexible supplies (and fixed factor prices) for labor and capital. Investment expenditures in his models are not distinguishable from household consumption. In this respect, Rickman's models more closely embody Kraybill's definition of Johansen closure than the requirements for neoclassical savings-investment behavior. Also, Rickman is modeling a large, multi-state region with a ten percent share of U.S. value added, whereas Kraybill is arguing with respect to state-level models imbedded in a multiregional framework.

Data Sources

Estimates of 1990 Oregon industrial output, factor demand (labor, proprietors, capital), imports, exports, consumption, government spending, and investment were generated using IMPLAN. On closer inspection, estimates for three of the 528 IMPLAN industrial sectors seemed particularly problematic, and were adjusted based on comparison with other secondary data sources. For example, employment and total sales for sector 6, "Sheep, Lambs and Goats" were reduced by a factor of twenty based on comparison with agricultural sales and employment data. Also, the IMPLAN total sales estimate for sector 505, "Religious Organizations" was reduced by a factor of ten based on consultation with IMPLAN troubleshooters and comparison with 1985 IMPLAN data. Finally, the estimate of total sales for IMPLAN sector 454, "Eating and Drinking Establishments" was doubled based on comparison with 1985 IMPLAN sales-to-employment ratios. A fortran program designed by Shankar Subramanian and adapted by Dave Holland was used to combine the adjusted IMPLAN regional accounts data into an import-ridden transaction matrix (Robinson, Subramanian and Geoghegan).

The IMPLAN distribution of consumption expenditures (in 1990 dollars) by household income category (i.e. "low" < $20,000, "medium" $20,000-$40,000, "high" > $40,000) was maintained. Mapping gross factor incomes into household incomes and factor taxes was done using proportions from the 1982 IMPLAN SAM for Oregon, and an industry by household income distribution matrix adapted from Rose, Stevens and

Davis (see Table 5.2, p.56). Total government transfer payments to individuals were estimated from BEA data (USDC/BEA 1993) and distributed to households using proportions from the 1982 IMPLAN SAM.

Particular attention was paid to accurately representing regional state and local education, non-education and federal government accounts. IMPLAN estimates of regional expenditures by the federal government were adjusted using independent data published by the Advisory Commission on Intergovernmental Relations (ACIR). Aggregate revenues and expenditures of education and non-education functions of state and local governments were estimated using Government Finances data (USDC/Bureau of the Census 1991, 1993). Aggregate payments of federal and state income tax, and local (education and non-education) property taxes were allocated across the household income distribution using official statistics (State of Oregon, Legislative Revenue Office; State of Oregon, Department of Revenue). IMPLAN estimates of indirect business tax payments by industries (i.e. sales, excise and property taxes) to federal and state and local governments were adjusted to conform with published control totals (USDC/Bureau of the Census 1991, 1993) using Oregon Department of Revenue estimates of total property tax collections.

CHAPTER 3

AN ILLUSTRATION OF CGE METHODOLOGY USING A TWO-SECTOR MODEL

A two-sector version of the Oregon CGE was used to demonstrate economy-wide adjustment to a stylized version of Ballot Measure 5. The very broadly aggregated industry and commodity sectors are referred to as "goods" (IMPLAN sectors 1 - 432), and "services" (IMPLAN sectors 433 - 528). Estimates of general equilibrium adjustments in output, income, government revenues and other macro variables are compared under flexible-price (CGE) and fixed-price (IO) modeling assumptions.

Impacts under FY 1996 Measure 5 property tax rates are compared with the pre-Measure 5 baseline scenario below. A key assumption is that assessed property values, which form the property tax base, remain at 1990 levels (note: this assumption is relaxed in Chapter 4 where estimates of projected 1995-96 tax revenues are used). Under these assumptions, Measure 5 reduces school property taxes paid by industries and households by $636.1 million (-73.4%), and $595.5 million (-74.5%), respectively, for an overall reduction in education tax revenues of 73.9%. At the same time, non-education property tax rates are allowed to increase to the maximum allowed under Measure 5. Non-education property taxes on industries and households thus increase by $23.7 million (5.4%), and $1 million (0.25%), respectively.

Results are compared under two different CGE modeling assumptions:

1. Neoclassical CGE, where all factor supplies are fixed interregionally (but intersectorally mobile) and endogenous factor prices adjust to restore equilibrium in the factor markets. In addition, external financial flows are fixed at base year levels, forcing investment to adjust endogenously to changes in regional savings.

2. Keynesian CGE, where labor supply adjusts endogenously to a fixed wage level. Supplies of other factors (proprietors, capital) are fixed interregionally but intersectorally mobile. Nominal investment is fixed at base year levels. Savings-investment equilibrium is maintained through endogenous inflows from the external financial account.

Under both specifications, expenditures by federal government and by the state and local government education accounts are fixed in real terms. Any surplus of regional federal government revenues, net of fixed expenditures, flows out from the region. Measure 5 directly reduces state and local education revenues. To maintain real base year expenditure levels, a transfer from the state and local government non-education account is necessary to fully replace lost education tax revenues. Commodity purchases by the regional non-education sector are determined as fixed shares of residual non-education revenues (i.e. net of exogenous transfers to households and endogenous transfers to the education account). Thus, any reductions in education tax revenues are accommodated by a transfer from the state and local non-education fund at the expense of other regional non-education spending.

For comparison, a third specification is also presented:

3. Fixed-price, where all factor supplies are interregionally and intersectorally elastic and all commodity and factor prices are fixed. Constant multipliers result from the assumption of fixed proportion, column-normalized expenditure coefficients. Factor incomes and household expenditures are assumed endogenous.

The fixed-price model embodies most of the traditional assumptions regarding regional economic systems. Since government, savings-investment and current accounts are all exogenous, the shock scenario was implemented differently than for the CGEs. Reduced tax collections were translated directly into exogenous reductions in government demand for goods and services. Household property tax savings were rebated to households exogenously. Industry property tax savings were assumed to accrue to capital income, which in turn is mapped by the enterprise account into household incomes.

While interpretation is generally straightforward, the absence of endogenous prices, exports, investment, and various financial and intergovernmental flows makes certain comparisons between the fixed-price and CGE model impossible. It should also be noted that the import-ridden SAM differs conceptually from the more traditional treatment of SAMs as import-purged. In the import-ridden case, commodity imports enter the region as goods and services which directly augment goods and services produced in the region. Total regional supply is thus composed of a mixture of imported and regionally produced commodities which satisfy the various components of regional demand.

In a typical import-purged SAM, we are mainly concerned with tracking the flow of those goods and services produced by industries in the region. Import purchases are treated in aggregate terms simply as leakages from each regional expenditure account to unidentified recipients outside the region. No attempt is made to connect the expenditure to the underlying bill of commodities which was purchased or to the sectors which produced the commodities.

Results of the Two-Sector Analysis

Results of the three simulations are presented in Table 2. All variables are expressed as percentage changes from base levels. All models show the expected reduction in regional education tax revenues, by -73.9% ($1,231 mil.) under both neoclassical CGE and fixed-price assumptions, and by -73.6% ($1,225 mil.) assuming Keynesian CGE closure. Compensating transfers from the state general fund (EDTRANS) to maintain fixed real education spending increase by 90.4% under neoclassical CGE closure and by 89.3% under Keynesian CGE closure. Regional government non-education tax revenues increase by 1.09% ($47 mil.) under neoclassical, by 1.23% ($53 under fixed-price, and by 2.4% ($102 mil.) under Keynesian closures. Non-education purchases (G) decrease by 18.82% under neoclassical, by 19.33% under fixed-price and by 17.22% under Keynesian closures. Since revenues collected by the federal government increase while expenditures are fixed, the region's net contribution to the federal budget (FEDFLO) increases by 13.84% ($85.2 mil.) under neoclassical closure and by nearly 38% ($234 mil.) under Keynesian closure.

The difference between the two CGE closures is mainly due to the different labor market specifications. Under neoclassical closure, the decline in government demand for goods and services is not quite offset by increases in consumption (C) and investment (IT). This results in marginal declines in total absorption (Q), demand for regional products (XXD), and their respective prices (P and PD). Lower relative prices induce a smaller proportional decline in demand for regional products than for imports (M). Exports (E) increase as industries react to relatively higher fixed world prices. There is a marginal reallocation of resources between goods and services industries. But since factor supplies are fixed, the decline in real output of goods (-0.02%) exceeds the increase in services output (0.01%), resulting in a net decrease in real aggregate output (X). All endogenous regional commodity prices decrease (with the exception of value added prices (PV), which are

Table 2. MEASURE 5 IMPACT UNDER ALTERNATIVE MODEL CLOSURES.

(% CHANGE)

	NEOCLASSICAL CGE			KEYNESIAN CGE			FIXED-PRICE IO		
GOVERNMENT	fed	non-ed	ed	fed	non-ed	ed	fed	non-ed	ed
G		-18.82			-17.22			-19.33	
STAX	1.04	1.04		2.57	2.57		-0.88	-0.88	
CTAX	1.04	1.04		2.56	2.56		6.15	6.15	
ITAX	-0.30	1.25	-73.50	1.09	2.70	-73.10	-0.94	0.59	-73.70
HTAX	0.78	1.00	-74.30	1.95	2.14	-74.00	1.54	1.69	-74.10
GOVSALES	-0.48	-0.48		0.45	0.57		-1.18	-1.23	
TAX REVENUE	0.84	1.09	-73.90	2.22	2.40	-73.60	0.40	1.23	-73.90
$ mil.	83	47	-1231	220	102	-1225	40	53	-1231
HOUSEHOLDS	low	med	high	low	med	high	low	med	high
C	1.37	1.67	4.69	2.06	3.15	6.30	0.76	0.17	2.08
HHY	0.27	0.79	0.84	0.67	1.95	2.09	0.76	0.17	2.08
HHYD	1.10	1.40	4.41	1.49	2.57	5.70	1.59	0.78	5.69
HHSAV	1.10	1.40	4.41	1.49	2.57	5.70	1.54	0.18	9.71
CONS. EXP.	1.10	1.40	4.41	1.49	2.57	5.70			

	NEOCLASSICAL CGE		KEYNESIAN CGE		FIXED-PRICE IO	
	GOODS	SERVS.	GOODS	SERVS.	GOODS	SERVS.
FACTOR DEMANDS						
L	-0.02	0.01	3.28	2.27	-0.55	-1.02
F	-0.02	0.01	0.60	-0.38	-0.55	-1.02
K	-0.02	0.01	0.70	-0.27	-0.55	-1.02
PRICES						
P	-0.08	-0.33	-0.36	-0.63		
PD	-0.18	-0.42	-0.77	-0.80		
PX	-0.08	-0.35	-0.36	-0.66		
PV	1.04	1.04	0.78	0.71		
QUANTITIES						
Q	-0.30	-0.06	1.20	1.41	-1.17	-1.24
X	-0.02	0.01	2.50	1.54	-0.55	-1.02
XXD	-0.16	-0.02	1.90	1.48	-1.17	-1.24
E	0.11	0.15	3.04	1.81		
M	-0.43	-0.19	0.68	1.16	-1.17	-1.24
IT	1.38	1.63	0.37	0.63		

	NEOCLASSICAL CGE	KEYNESIAN CGE	FIXED-PRICE IO
MACRO SCALARS			
EXOSAV		-20.99	
CADEF	-1.85	-6.95	
FEDFLO	13.84	37.99	
EDTRANS	90.41	89.28	
LTOT		2.57	-0.88
FTOT			-0.84
KTOT			-0.89
FACTOR PRICES			
WSTAR	1.04		
W	1.04		
PP	1.04	2.66	
RSTAR	1.04	2.56	
R	1.04	2.56	
FACTOR INCOMES			
LABY	1.04	2.57	-0.88
PROPY	1.04	2.66	-0.84
CAPY	1.04	2.56	6.15

simply the proportion of unit revenues (PX) net of interindustry purchases and indirect business taxes).

Under Keynesian closure, declining regional government demand is more than compensated by increasing consumption, thereby increasing absorption of Q, XXD and M. Endogenous labor supplies allow employment (LTOT) and aggregate output (X) to expand in real terms, as does E. Since wages are fixed and capital and proprietors are relatively scarce, gross prices for capital (RSTAR) and proprietors' services (PP) rise by double the amount of increase under neoclassical closure. The decline in commodity and output prices (P, PD and PX) is also more pronounced, e.g. for goods quadruple, and for services, nearly double their fall under neoclassical closure. Household incomes (HHY) increase roughly in proportion to changes in factor incomes generated by the two models. Under Keynesian CGE closure, household incomes increase by more than twice as much as under neoclassical closure.

In contrast to the two CGE closures, the fixed-price model shows significant decreases in regional absorption and output. Decreased factor demand translates into reduced factor incomes. These are offset, however, by exogenous tax rebates so that net household (and capital) incomes increase. Consumption also increases but not sufficiently to offset reduced government expenditures. This is because the redistribution of purchasing power from government to households increases leakage in the form of taxes and import purchases. A smaller number of endogenous accounts in the fixed-price model results in smaller regional multipliers.

Summary of Two-Sector CGE Demonstration

Tax reduction under Measure 5 transfers purchasing power from the government to households. Different model specifications predict qualitatively different results. Flexible-price models find the most efficient allocation of substitutable resources in terms of the relative marginal valuations of producers and consumers, expressed as endogenous prices. Fixed-price models simply adjust real purchases according to existing expenditure proportions. The Keynesian CGE closure utilizes elastic supplies of labor and finance to produce the greatest response, predicting real increases in regional output, incomes, and consumption, as well as more favorable government and other macro balances. The neoclassical CGE, constrained by inelastic factor supplies, responds by shifting factors between sectors to produce marginal increases or decreases in regional economic aggregates. The fixed-price model is most pessimistic, predicting the smallest increase in household incomes and consumption, and uniformly negative changes in regional output and absorption.

The fixed-price results are generally in sharp contrast to the CGE analysis, although it should be kept in mind that in certain respects the two models are not directly comparable. Many variables which are determined endogenously in the CGE models are necessarily exogenous in traditional fixed-price analysis. For example, in the CGE scenarios, only the counterfactual tax rates need be exogenously set. Output, absorption, income, revenue and spending variables are then determined in the model. In the fixed-price analysis, on the other hand, after setting counterfactual tax rates, the associated change in government spending must also be exogenously allocated among the sectors of origin, and the private tax savings must be exogenously rebated to the relevant institutions (households, factors) in the model.

In the absence of endogenous prices, response in the fixed-price model consists of quantity adjustment only. Hence, output, factor demand and commodity absorption all decline in fixed proportions. Fixed-price models can generally be described as providing an **upper bound** on the magnitude of regional supply adjustment to an exogenous shock. In Table 2 this trend holds (in absolute terms) for all sectoral quantity variables. However the necessarily different structure of the two models means that certain household income and government revenue estimates obtained using the fixed-price model seem to violate the upper bound rule.

CGE models spread the adjustment response between quantity and price components, smoothing the transition to a new equilibrium. In this respect, CGE models probably describe a **lower bound** on the impact on regional supply. By varying the elasticities of factor supplies, CGE results ranging from marginal decline to significant growth were demonstrated for the tax reduction scenario.

It should be noted that these results are meaningful only in a static, current accounting sense. Since preferences for public goods are separable from preferences for private consumption, any possible interactions between government activity and private well being are ignored. As a result, the contribution of government investment and public services to regional well-being is undervalued. In the long run, continuing neglect of public infrastructure and essential services could be expected to outweigh the benefit of any static increase in private incomes. The relatively pessimistic results of the fixed-price formulation seem to reflect this concern but for the wrong reasons. In the fixed-price model, economic decline results not from any long run deterioration of productive infrastructure, but from the fundamentally different nature of government and household current spending patterns. Household expenditures are subject to greater leakage in the form of import purchases and taxes. In addition, fixed-price models fail to capture factor and commodity substitution responses which are integral to modern economic theory.

CHAPTER 4

TAX INCIDENCE ANALYSIS OF MEASURE 5 USING A NINE-SECTOR CGE MODEL

In this chapter, a nine-sector version of the Oregon CGE model is used to analyze economy-wide adjustment to property tax changes under Measure 5. Three different alternatives were investigated using the model: a differential or revenue neutral analysis, and two separate balanced budget treatments. Results for each scenario are compared against baseline flows under varying assumptions regarding the interregional mobility of labor and financial flows, and the intersectoral mobility of capital. The different model variants are categorized as follows:

> **neoclassical CGE** (N): i.e. fixed interregional labor supply and financial flows with endogenous investment expenditures, assuming mobile intersectoral capital (m), or fixed intersectoral capital (f). These variants are herein labeled "**Nm**" and "**Nf**", respectively.
>
> **Keynesian CGE** (K): i.e. mobile interregional labor supply and financial flows with exogenous investment expenditures, assuming mobile intersectoral capital (m), or fixed intersectoral capital (f). These variants are herein labeled "**Km**" and "**Kf**", respectively.

The relationship between these variants can perhaps be expressed in terms of the operative time frame of the analysis. In the very short term, it seems reasonable that labor, capital and financial flows would be relatively inelastic. Variant **Nf** (neoclassical CGE with fixed intersectoral capital) probably best approximates economic adjustment in the short term. From a longer term perspective, we would expect to see greater mobility of labor, capital and financial flows. Variant **Km** (Keynesian CGE with mobile intersectoral capital) best accommodates these adjustments in the longer term. Somewhere in between these two cases lie the other two variants: **Nm** (neoclassical CGE with mobile intersectoral capital), and **Kf** (Keynesian CGE with fixed intersectoral capital).

The nine industry and commodity classifications used in this version of the model are: 1. **Agriculture and Natural Resources** ("ANR", consisting of IMPLAN sectors 1-47); 2. **Construction** (IMPLAN sectors 48-57); 3. **Manufacturing** (IMPLAN sectors 58-132, 148-160, 167, 174-432); 4. **Logging, Wood and Paper Products** ("TIMBER", IMPLAN sectors 133-147, 161-166, and 168-173); 5. **Transportation, Communication and Utilities** ("TCU", IMPLAN sectors 433-446, 511, and 514); 6. **Trade** (IMPLAN sectors 447-455, 463); 7. **Finance, Insurance and Real Estate** ("FIRE", IMPLAN sectors 456-462); 8. **Services** (IMPLAN sectors 464-509); and 9. **Government Enterprise, Government Industry, Household Industry and Other** ("GOVT", IMPLAN sectors 510, 512, 513, 515-528). GOVT is something of a residual category dominated by Government Industry, which is primarily a mechanism for transmitting demand for factor services by the three government expenditure accounts to the factor accounts. For purposes of discussion, sectors 1 - 4 are classified as "goods", and sectors 5 - 9 are considered "services".

The sectoring scheme used for this analysis is considerably more detailed than the two-sector specification demonstrated above, although still considerably more aggregated than the 528 sector IMPLAN format. The nine-sector scheme was adopted because it allows separate treatment of ANR and TIMBER industries, which are important in Oregon. It also permits construction of a model which is compact enough to be solved in a fairly short amount of time using a non-proprietary, AT-based version of the GAMS software. Solution times for the various analyses were in the range of two to five minutes using an IBM compatible 80286/87 personal computer.

In the first of the two balanced budget treatments presented below (scenario I), commodity purchases by state and local education programs were fixed in real terms, as they were in the two-sector CGE demonstration in Chapter 3. Reduced education-related property tax revenues were compensated by transfers from state and local government non-education functions at the expense of other spending programs. In the other balanced budget treatment (scenario II), expenditures by state and local non-education programs were fixed in real terms. Reduced education revenues were thereby directly transmitted as reductions in state and local government expenditures on education.

In the differential incidence analysis (scenario III), all government expenditures were fixed in real terms. Collections of state income taxes from high income category households were allowed to increase endogenously in order to recover sufficient revenues to maintain real baseline levels of state and local government expenditure.

State estimates of 1995 property tax revenues were used to construct the Measure 5 shock scenarios. This results in a more realistic representation of the direct effect under Measure 5 than was illustrated in Chapter 3. To do this property taxes were split into two exogenous components: a **tax rate** and an **assessment valuation.** These two components are multiplied together to determine total property tax payments to state and local government by each industry and household account. Since revenue projections incorporate anticipated expansion of the property tax base, the effect of reduced tax rates is partially offset by increasing real property values. Economy-wide impacts are therefore considerably less than estimated in Chapter 3.

Changes in real household purchasing power were measured using **Laspeyres quantity indices.** A quantity index compares counterfactual household commodity purchases with baseline consumption using given commodity prices as weights. The Laspeyres quantity index (58) uses baseline commodity prices as weights (P_i^o), while a Paasche index (59) uses counterfactual equilibrium prices (P_i^1).

$$\lambda_{hh}=\sum_{i=1}^{n} C_{i,hh}^{1}\times P_i^{o} / \sum_{i=1}^{n} C_{i,hh}^{o}\times P_i^{o} \qquad (58)$$

$$\Pi_{hh}=\sum_{i=1}^{n} C_{i,hh}^{1}\times P_i^{1} / \sum_{i=1}^{n} C_{i,hh}^{o}\times P_i^{1} \qquad (59)$$

Laspeyres quantity indices were selected due to simplicity of calculation and uniformity of the base (i.e. actual baseline expenditures). In a CGE model, baseline commodity prices are all set equal to one. Hence the Laspeyres index for each household category is calculated simply as the ratio of counterfactual real consumption to baseline real consumption.

Baseline values for selected model variables are presented in Table 3. Results for all subsequent incidence analyses are compared against these baseline values. Several notable characteristics of the Oregon economy are discernable from examination of Table 3: Services is the largest sector in terms of total output (X) ($15,857 mil.), followed closely by Manufacturing ($15,293 mil.). In terms of absorption (Q), Manufacturing ($22,392 mil.) is the most important sector, exceeding services ($17,433 mil.) by a wide margin. Regional exports (E) of

Table 3. BASELINE RESULTS FOR MAJOR ECONOMIC VARIABLES. (PRICES AND INDICES ARE UNITS; QUANTITIES ARE MILLIONS)

A. SECTORAL FACTOR DEMAND

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT	TOTAL
LAB	1172.51	2193.99	4226.05	2461.05	2306.50	6500.10	1851.38	6354.22	6529.60	33595
PROP	1032.13	511.90	125.47	157.61	338.30	390.63	65.37	2082.97		4704
CAP	317.73	147.18	1316.15	735.23	2041.31	878.21	2291.45	630.95	348.81	8707
TOTAL	2522	2853	5668	3354	4686	7769	4208	9068	6878	

B. SECTORAL PRICE AND QUANTITY RESULTS

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT	TOTAL
P	1	1	1	1	1	1	1	1	1	
PD	1	1	1	1	1	1	1	1	1	
PX	1	1	1	1	1	1	1	1	1	
PV	0.25	0.39	0.37	0.34	0.56	0.66	0.47	0.57	0.92	
Q	10347.56	7169.31	22392.27	4340.28	9429.09	11069.67	10555.40	17432.65	7919.78	100656
X	9978.28	7298.83	15292.60	9890.19	8447.44	11804.69	8927.37	15856.76	7443.76	94940
XXD	4136.15	7090.49	5613.77	3101.23	6286.74	9554.23	7013.90	13483.91	6842.43	63122
E	5842.13	208.34	9678.83	6788.96	2160.70	2250.46	1913.47	2372.85	601.33	31817
M	5326.37	78.82	16724.35	1239.04	3003.27	1048.18	3541.09	3541.36	1050.05	35553
ND	6829.32	1543.28	12877.01	3567.13	5723.18	2610.10	4235.40	6400.36	917.48	44703
LABY	974.94	1824.30	3513.96	2046.36	1917.86	5404.83	1539.42	5283.53	5429.36	27935

C. GOVERNMENT SALES AND TAX REVENUES

	FED	NED	ED	TOTAL
SALES	680.62	1300.01		1981
BUSTAX		429.81	866.16	1296
EXCTAX	749.16	1112.34		1862
ITAXES	749.16	1542.15	866.16	3157
PROTAX		402.76	799.50	1202
INCTAX	3874.04	1831.47		5706
HTAXES	3874.04	2234.23	799.50	6908
LAB	4827.66	347.79		5175
CAP	484.72	145.88		631
TOTAL	16072	10180	1666	

D. DISTRIBUTION OF HOUSEHOLD INCOME, SAVINGS AND AVERAGE STATE INCOME TAX RATES

	LOW	MED	HI	TOTAL
Y	9202.80	22186.17	16854.45	48243
YD	8579.58	20504.47	12251.60	41336
S	95.62	490.66	2020.31	2607
TAX RATE	0.021	0.023	0.069	

E. REAL GOVERNMENT SPENDING, INVESTMENT AND HOUSEHOLD CONSUMPTION

	FED	NONED	EDU	INVEST	LOW	MED	HI	TOTAL
ANR	91.48	144.35	13.01	199.22	800.43	1521.82	747.93	3319
CONSTR	253.09	1156.91	1057.69	3158.34	0	0	0	2468
MANU	260.36	893.38	495.10	1564.19	1174.87	3308.98	1818.38	7951
TIMBER	5.27	47.00	5.38	363.05	88.69	184.03	79.73	410
TCU	276.19	305.41	175.33	206.34	607.69	1368.07	766.88	3500
TRADE	11.78	208.36	96.78	208.3	1618.28	3932.04	2384.03	8251
FIRE	1.97	33.78	45.55	96.17	1444.61	3897.35	800.57	6224
SERVS	47.89	234.67	133.88	167.95	2384.26	4865.94	3197.70	10864
GOVT	1043.15	3197.40	1356.10	3.94	298.41	753.64	349.66	6998
TOTAL	1991	6221	3379	5968	8417	19832	10145	
LASPEYRES	1	1	1	1	1	1	1	

F. OTHER BASELINE SCALARS

CADEF	6800.48	FEDFLO	-616.0	EDTRANS	1353.16	CADJ	2172.19
WSTAR	1.0	W	0.846	PP	1.0	RSTAR	1.0
R	0.499	PROPY	4704.38	CAPY	2176.76	ENTY	8215.6
DEPREC	3727.48	RETEARN	714.4	EXOSAVE	3360.9	LTOT	33595.4

G. VARIOUS INDUSTRY QUANTITY COMPARISONS (RANKING IN PARENTHESES)

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
TOTAL OUTPUT	9978 (4)	7299 (9)	15293 (2)	9890 (5)	8447 (7)	11805 (3)	8927 (6)	15857 (1)	7444 (8)
LABOR/OUTPUT	.118 (9)	.301 (4)	.276 (5)	.249 (7)	.273 (6)	.551 (2)	.207 (8)	.401 (3)	.877 (1)
PROP/OUTPUT	.103 (2)	.070 (3)	.008 (7)	.016 (6)	.040 (4)	.033 (5)	.007 (8)	.131 (1)	0 (9)
CAPITAL/OUTPUT	.032 (8)	.020 (9)	.086 (3)	.074 (5)	.242 (2)	.074 (4)	.257 (1)	.040 (7)	.047 (6)

manufactured goods ($9,679 mil.), exceeded the next largest export categories, Timber-related products ($6,789 mil.) and primary commodities (ANR) ($5,842 mil.), by wide margins. Manufactured goods are also the largest category of imports (M) ($16,724 mil.) and intermediate demand (ND) ($12,877 mil.). The major component of investment (IT) is Construction services ($3,158 mil.).

On the fiscal side, State and local government non-education revenues are derived chiefly from personal income tax collections ($1,831 mil.), sales of goods and services by government agencies ($1,300 mil.) and industry excise taxes ($1,112 mil.). State and local education revenues are derived mainly from property taxes on businesses ($866 mil.) and private residences ($799 mil.). Federal government revenues are chiefly from payroll taxes ($4,828 mil.), and personal income taxes ($3,874 mil.).

The largest category of State and local government expenditure in both percentage and absolute terms was GOVT (payrolls for government employees). Total non-education payments for GOVT services ($3,197 mil.) were more than double payments by education ($1,356 mil.). The next largest category of total state and local government expenditure was Construction ($2,215 mil.). Education spent more for Construction in percentage terms (31% v. 19%), but non-education spending on Construction was greater in absolute terms ($1,157 mil. v. $1,058 mil.). Federal government expenditures are dominated by payments to GOVT, primarily for labor services ($1,043 mil.).

The composition of household consumption was qualitatively different than government expenditures, and varied according to household income category. Households made no direct purchases from Construction. Rather, expenditures for maintenance of residential structures are treated as direct household purchases of real estate services (FIRE). "FIRE", in turn, makes the corresponding purchase of construction services. The major component of household consumption was Services ($10,448 mil.). Low, medium and high income households spent 27.8%, 23.7% and 26.1%, respectively, of disposable income on Services. Trade margins ($7,934 mil.) were the next most important consumption category. The three household classes spent 18.8%, 19.2% and 19.5%, respectively, of disposable income on Trade margins. While expenditure for financial services (FIRE) was the third largest expenditure category for both low and medium income households (18.9% and 19.2%, respectively), it was considerably less important for the high income group (6.5%). Savings rates were very different for the three household classes (1.1%, 2.4% and 16.5%, respectively).

It is also instructive to comment on the relative factor intensities of industries in the model. For this comparison, factor intensities are calculated as industry payments to each factor as a proportion total industry output. By this measure, the GOVT sector (due to the inclusion of Government Industry) is the most labor-intensive industry category, followed by Trade and Services. FIRE is the most capital-intensive industry, followed by TCU. Services are most heavily dependent on proprietors' input, followed by ANR-related industries.

Scenario I: Balanced Budget Incidence With Fixed S/L Education Spending

The treatment of state and local government sectors in this analysis is analogous to the demonstration scenario in Chapter 3. Results of this simulation under neoclassical CGE and Keynesian CGE closures and assumptions of mobile and fixed intersectoral capital endowment are presented below. Variables are expressed as percentage changes from base levels.

Mobile Intersectoral Capital (See Tables 4 and 5)

Both neoclassical (Nm) and Keynesian (Km) model specifications show reduction in local education tax collections from industries (BUSTAXES) and households (PROTAXES) of (-)61.9% and (-)59.35%, respectively. Non-education property tax collections from industries and households increased by 32.8% and 37.3%, respectively. Compensating transfers from the non-education account (EDTRANS) to maintain fixed real education spending increased by 75.2% under neoclassical and by 74.7% under Keynesian CGE closures. Commodity purchases for state and local non-education programs (G) decreased by 11.3% under neoclassical, and by 10.6% under Keynesian closures. Since revenues collected by the federal government increased while expenditures were fixed, the region's net contribution to the federal budget (FEDFLO) increased by 15.6% under neoclassical and by 25.2% under Keynesian closures.

Table 4. BALANCED BUDGET SCENARIO I: FIXED S/L EDUCATION EXPENDITURE (Nm)
(NEOCLASSICAL CLOSURE; MOBILE INTERSECTORAL CAPITAL)

(% CHANGE)

A. SECTORAL FACTOR DEMAND

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
LAB	4.086	-1.2	-0.036	1.02	0.944	1.769	2.299	0.908	-4.322
PROPR	2.6	-2.61	-1.463	-0.421	-0.496	0.317	0.839	-0.532	
CAP	2.946	-2.282	-1.131	-0.086	-0.161	0.655	1.179	-0.197	-5.369

B. SECTORAL PRICE AND QUANTITY RESULTS

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
P	-0.454	0.186	0.043	-0.108	-0.091	-0.95	-0.662	0.323	0.404
PD	-0.933	0.188	0.169	-0.151	-0.133	-1.049	-0.996	0.405	0.466
PX	-0.385	0.182	0.062	-0.047	-0.099	-0.849	-0.782	0.345	0.428
PV	1.138	0.723	0.695	0.717	0.993	0.604	1.032	0.815	0.462
Q	1.673	-1.499	0.027	0.487	0.326	1.444	1.44	0.556	-4.337
X	3.332	-1.51	-0.323	0.709	0.357	1.569	1.665	0.498	-4.375
XXD	2.481	-1.502	-0.163	0.552	0.343	1.487	1.577	0.522	-4.361
E	3.932	-1.779	-0.416	0.78	0.397	1.916	1.984	0.36	-4.538
M	1.049	-1.225	0.09	0.324	0.29	1.06	1.171	0.685	-4.183
ND	2.026	0.362	0.192	0.535	0.508	0.339	1.212	0.508	0.735
LABY	4.509	-0.799	0.37	1.431	1.354	2.182	2.714	1.318	-3.933

C. GOVERNMENT SALES AND TAX REVENUES

	FED	NED	ED
SALES	0.53	0.602	
BUSTAXES		32.826	-61.901
EXCTAXES	1.474	1.418	
ITAXES	1.474	10.171	-61.901
PROTAXES		37.308	-59.35
INCTAXES	1.515	0.494	
HTAXES	1.515	7.131	-59.35
LAB	0.406	0.406	
CAP	1.517	1.517	

D. HOUSEHOLD INCOME AND SAVINGS

	LOW	MED	HI
Y	0.404	0.475	0.527
YD	0.85	0.877	1.919
S	0.85	0.877	1.919

E. REAL GOVERNMENT SPENDING, INVESTMENT AND HOUSEHOLD CONSUMPTION

	FED	NONED	ED	INVEST	LOW	MED	HI
ANR	0	-11.272	0	1.195	1.31	1.337	2.384
CONSTR	0	-11.272	0	0.549			
MANU	0	-11.272	0	0.692	0.807	0.834	1.875
TIMBER	0	-11.272	0	0.844	0.959	0.986	2.029
TCU	0	-11.272	0	0.827	0.942	0.969	2.011
TRADE	0	-11.272	0	1.702	1.818	1.845	2.897
FIRE	0	-11.272	0	1.407	1.522	1.549	2.598
SERVS	0	-11.272	0	0.411	0.525	0.552	1.591
GOVT	0	-11.272	0	0.33	0.444	0.471	1.509
LASPEYRES	0	-11.272	0	0.7	1.1	1.1	2.1

F. OTHER SCALARS

CADEF	-2.284	FEDFLO	15.609	EDTRANS	75.18	CADJ	1.517
WSTAR	0.406	W	0.406	PP	1.86	RSTAR	1.517
R	1.517	PROPY	1.86	CAPY	1.517	ENTY	0.37
DEPREC	0.406	RETEARN	0.37	EXOSAVE	0	LTOT	0

Table 5. BALANCED BUDGET SCENARIO I: FIXED S/L EDUCATION EXPENDITURE (Km)
(KEYNESIAN CLOSURE; MOBILE INTERSECTORAL CAPITAL)

(% CHANGE)

A. SECTORAL FACTOR DEMAND

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
LAB	5.284	-0.997	1.356	3.187	2.142	2.603	3.314	1.734	-3.754
PROPR	2.839	-3.296	-0.999	0.79	-0.23	0.22	0.915	-0.629	
CAP	2.955	-3.187	-0.887	0.904	-0.118	0.333	1.029	-0.516	-5.883

B. SECTORAL PRICE AND QUANTITY RESULTS

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
P	-0.458	0.054	-0.019	-0.426	-0.029	-1.15	-0.579	0.238	0.096
PD	-0.94	0.054	-0.074	-0.595	-0.043	-1.27	-0.872	0.298	0.111
PX	-0.388	0.053	-0.027	-0.186	-0.032	-1.027	-0.684	0.254	0.102
PV	1.251	0.538	0.573	0.603	1.151	0.372	1.263	0.698	0.114
Q	2.301	-1.524	0.623	1.679	0.97	2.071	1.829	1.072	-3.854
X	3.983	-1.527	0.778	2.569	0.98	2.223	2.026	1.029	-3.863
XXD	3.12	-1.525	0.707	1.939	0.976	2.123	1.949	1.047	-3.86
E	4.592	-1.605	0.819	2.856	0.993	2.646	2.307	0.927	-3.903
M	1.668	-1.445	0.595	1.03	0.958	1.602	1.593	1.168	-3.817
ND	2.803	0.984	1.035	1.947	1.399	1.109	1.744	1.105	1.509
LABY	5.284	-0.997	1.356	3.187	2.142	2.603	3.314	1.734	-3.754

C. GOVERNMENT SALES AND TAX REVENUES

	FED	NED	ED
SALES	1.12	1.078	
BUSTAXES		32.826	-61.901
EXCTAXES	2.05	2.069	
ITAXES	2.05	10.642	-61.901
PROTAXES		37.308	-59.35
INCTAXES	1.956	0.914	
HTAXES	1.956	7.475	-59.35
LAB TAX	0.955	0.955	
CAP TAX	2.262	2.262	

D. HOUSEHOLD INCOME AND SAVINGS

	LOW	MED	HI
Y	0.725	0.871	0.972
YD	1.177	1.279	2.387
S	1.177	1.279	2.387

E. REAL GOVERNMENT SPENDING, INVESTMENT AND HOUSEHOLD CONSUMPTION

	FED	NONED	ED	INVEST	CLOW	CMED	CHI
ANR	0	-10.609	0	0.46	1.642	1.745	2.858
CONSTR	0	-10.609	0	-0.054			
MANU	0	-10.609	0	0.019	1.196	1.298	2.406
TIMBER	0	-10.609	0	0.428	1.609	1.712	2.825
TCU	0	-10.609	0	0.029	1.206	1.309	2.417
TRADE	0	-10.609	0	1.163	2.353	2.457	3.578
FIRE	0	-10.609	0	0.583	1.766	1.869	2.984
SERVS	0	-10.609	0	-0.237	0.937	1.039	2.144
GOVT	0	-10.609	0	-0.096	1.079	1.181	2.288
LASPEYRES	0	-10.609	0	0.1	1.5	1.6	2.7

F. OTHER SCALARS

CADEF	-4.4	FEDFLO	25.213	EDTRANS	74.732	CADJ	2.262
WSTAR	0	W	0	PP	2.378	RSTAR	2.262
R	2.262	PROPY	2.378	CAPY	2.262	ENTY	0.551
DEPREC	1.3E-07	RETEARN	0.551	EXOSAVE	-1.655	LTOT	0.955

For the three household categories, total income (HHY) increased by 0.404%, 0.475% and 0.527% for low, medium and high income households, respectively, under neoclassical closure; and by 0.725%, 0.871% and 0.972%, respectively, under Keynesian closure. Disposable income (HHYD) increased by 0.85%, 0.877% and 1.919%, respectively, under neoclassical closure; and by 1.177%, 1.279% and 2.387%, respectively, under Keynesian closure. High income households received relatively more property tax relief than low or medium income households. Consequently HHY and HHYD increased proportionately more for high income households than for medium or low income households. Increases in total income were at least 80% greater, and, for disposable income, at least 24% greater, under Keynesian than under neoclassical closure. Total labor utilization (LTOT) was 0.96% greater under Keynesian closure than under neoclassical closure (where labor supply is fixed).

Comparing Laspeyres quantity indices, each household category appeared slightly better off than was indicated by comparing disposable incomes. This result is due to a small reduction in prices (P) for most of the commodity categories consumed by households. Improvement in Laspeyres quantity indices ranged from 1.1% to 2.1% under neoclassical closure, and from 1.5% to 2.7% under Keynesian closure. Again, high income households benefited proportionately more than either low or medium income households.

Under both closures, the decline in government demand for goods and services was offset by increases in private consumption in all but two sectors, Construction and GOVT, as reflected by changes in total absorption (Q). Construction was the second largest category of state and local government expenditure, following GOVT. Households made no direct purchases from the Construction sector in the model. Results for industry output (X), generally paralleled changes in Q with the exception of Manufacturing under neoclassical closure, where Q increased by 0.03% but X decreased by (-)0.32%. The corresponding prices for absorption (P) and for output (PX) moved slightly (i.e. not more than (+/-) 1.15%), and generally in the direction opposite to movements in Q and X, with the exception of Services under both closures, where P and PX both increased along with Q and X; and Manufacturing under neoclassical closure where P and Q both increased slightly.

Demand for regional products (XXD) generally reflected changes in total absorption, except for Manufacturing under neoclassical closure, where imports (M) increased as substitutes for XXD. The corresponding price for regional products (PD) generally moved in the opposite direction to XXD, with the exception of Services under both closures, where PD increased as did XXD. This pattern was repeated under all variants of scenarios I and II, reflecting the relatively large share of household income spent on the aggregate Services commodity, and the result that aggregate disposable income generally increased proportionately more than did PD.

Exports (E) increased for all sectors, with the exception of Construction and GOVT under both closures, and Manufacturing under neoclassical closure. Exports generally moved in the direction opposite to PD, with the exception of Services under both closures, where the increase in total output response (X) outweighed the effect of any price-induced switching between export and regional markets. (Note: These results were generally consistent across both balanced budget scenarios (i.e. I and II)).

Imports (M) generally moved in the direction opposite to PD, with the exception of Services under both closures, and Manufacturing under neoclassical closure, in which cases the increase in total absorption response outweighed the effect of any price-induced substitution between imported and regional commodities.

Substitution of labor for the other two factors was greater under Keynesian closure, where labor's marginal cost was held constant relative to the other factors. Changes in sector output were generally reflected by corresponding changes in utilization of all three factors (labor, proprietors and capital). Exceptions to this include Services and TCU under both closures, Manufacturing under Keynesian closure and Timber under neoclassical closure. In these cases utilization of proprietors' and capital services decreased although output increased.

Fixed Intersectoral Capital (See Tables 6 and 7)

Neoclassical (Nf) and Keynesian (Kf) model specifications show reduction in local education tax collections from industries (BUSTAXES) and households (PROTAXES) of (-)61.9% and (-)59.35%, respectively. Non-education property tax collections from industries and households increased by 32.8% and 37.3%, respectively. Compensating transfers from the non-education account (EDTRANS) to maintain fixed real education spending increased by 74.9% under neoclassical and by 74.3% under Keynesian CGE closures. Commodity purchases for state and local non-

Table 6. BALANCED BUDGET SCENARIO I: FIXED S/L EDUCATION EXPENDITURE (Nf)
(NEOCLASSICAL CLOSURE; FIXED INTERSECTORAL CAPITAL)

(% CHANGE)

A. SECTORAL FACTOR DEMAND

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
LAB	3.489	-1.322	0.353	1.085	0.889	1.775	2.636	0.846	-4.471
PROPR	2.171	-2.578	-0.925	-0.202	-0.396	0.479	1.329	-0.438	

B. SECTORAL PRICE AND QUANTITY RESULTS

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
P	-0.312	0.119	-0.013	-0.123	-0.14	-0.878	-0.255	0.31	0.152
PD	-0.641	0.121	-0.049	-0.172	-0.205	-0.97	-0.383	0.389	0.175
PX	-0.265	0.117	-0.018	-0.054	-0.153	-0.784	-0.301	0.33	0.161
PV	1.373	0.571	0.519	0.707	0.89	0.673	1.861	0.764	0.176
Q	1.373	-1.474	0.14	0.534	0.36	1.392	1.086	0.546	-4.235
X	2.504	-1.481	0.243	0.786	0.408	1.507	1.172	0.491	-4.249
XXD	1.925	-1.476	0.196	0.608	0.387	1.431	1.139	0.514	-4.244
E	2.912	-1.654	0.27	0.867	0.469	1.827	1.294	0.358	-4.311
M	0.946	-1.297	0.121	0.349	0.304	1.037	0.983	0.67	-4.177
ND	1.641	0.237	0.349	0.588	0.534	0.364	0.951	0.467	0.685
LABY	3.911	-0.919	0.763	1.498	1.301	2.19	3.055	1.258	-4.081
R, RSTAR	3.911	-0.919	0.763	1.498	1.301	2.19	3.055	1.258	-4.081

C. GOVERNMENT SALES AND TAX REVENUES

	FED	NED	ED
SALES	0.52	0.596	
BUSTAXES		32.826	-61.901
EXCTAX	1.203	1.223	
ITAXES	1.203	10.031	-61.901
PROTAXES		37.308	-59.35
INCTAX	1.502	0.482	
HTAXES	1.502	7.121	-59.35
LAB	0.409	0.409	
CAP	1.627	1.627	

D. HOUSEHOLD INCOME, SAVINGS AND AVERAGE STATE INCOME TAX RATES

	LOW	MED	HI
Y	0.403	0.468	0.511
YD	0.849	0.869	1.902
S	0.849	0.869	1.902

E. REAL GOVERNMENT SPENDING, INVESTMENT AND HOUSEHOLD CONSUMPTION

	FED	NONED	ED	INVEST	CLOW	CMED	CHI
ANR	0	-11.112	0	1.044	1.164	1.185	2.221
CONSTR	0	-11.112	0	0.609			
MANU	0	-11.112	0	0.742	0.861	0.882	1.915
TIMBER	0	-11.112	0	0.853	0.973	0.993	2.027
TCU	0	-11.112	0	0.87	0.99	1.011	2.045
TRADE	0	-11.112	0	1.621	1.742	1.763	2.805
FIRE	0	-11.112	0	0.986	1.106	1.127	2.162
SERVS	0	-11.112	0	0.418	0.538	0.558	1.587
GOVT	0	-11.112	0	0.576	0.696	0.716	1.747
LASPEYRES	0	-11.1	0	0.7	1	1.1	2.1

F. OTHER SCALARS

CADEF	-2.361	FEDFLO	15.765	EDTRANS	74.868	CADJ	1.627
WSTAR	0.409	W	0.409	PP	1.704	RSTAR	
R		PROPY	1.704	CAPY	1.627	ENTY	0.397
DEPREC	1.627	RETEARN	0.397	EXOSAVE	0	LTOT	0

Table 7. BALANCED BUDGET SCENARIO I: FIXED S/L EDUCATION EXPENDITURE (Kf)
(KEYNESIAN CLOSURE; FIXED INTERSECTORAL CAPITAL)

(% CHANGE)

A. SECTORAL FACTOR DEMAND

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
LAB	4.708	-1.188	1.649	2.712	1.927	2.499	3.505	1.571	-3.97
PROPR	2.525	-3.247	-0.47	0.571	-0.198	0.363	1.348	-0.546	

B. SECTORAL PRICE AND QUANTITY RESULTS

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
P	-0.347	-0.046	-0.07	-0.32	-0.119	-1.127	-0.26	0.183	-0.186
PD	-0.712	-0.046	-0.276	-0.448	-0.175	-1.244	-0.391	0.23	-0.215
PX	-0.294	-0.045	-0.101	-0.14	-0.13	-1.007	-0.307	0.196	-0.198
PV	1.452	0.317	0.427	0.688	0.988	0.386	1.927	0.594	-0.205
Q	1.944	-1.502	0.637	1.344	0.888	1.957	1.461	1.004	-3.791
X	3.209	-1.5	1.217	2.01	0.929	2.106	1.548	0.971	-3.773
XXD	2.561	-1.502	0.95	1.539	0.911	2.007	1.514	0.985	-3.78
E	3.667	-1.433	1.371	2.225	0.982	2.52	1.673	0.892	-3.697
M	1.467	-1.57	0.532	0.858	0.84	1.498	1.355	1.077	-3.862
ND	2.359	0.786	1.069	1.57	1.258	1.002	1.448	0.989	1.336
LABY	4.708	-1.188	1.649	2.712	1.927	2.499	3.505	1.571	-3.97
R,RSTAR	4.708	-1.188	1.649	2.712	1.927	2.499	3.505	1.571	-3.97

C. GOVERNMENT SALES AND TAX REVENUES

	FED	NED	ED
SALES	0.993	0.952	
BUSTAXES		32.826	-61.901
EXCTAX	1.736	1.811	
ITAXES	1.736	10.455	-61.901
PROTAXES		37.308	-59.35
INCTAX	1.843	0.806	
HTAXES	1.843	7.386	-59.35
LAB	0.827	0.827	
CAP	2.211	2.211	

D. HOUSEHOLD INCOME AND SAVINGS

	LOW	MED	HI
Y	0.649	0.773	0.856
YD	1.099	1.18	2.265
S	1.099	1.18	2.265

E. REAL GOVERNMENT SPENDING, INVESTMENT AND HOUSEHOLD CONSUMPTION

	FED	NONED	ED	INVEST	CLOW	CMED	CHI
ANR	0	-10.484	0	0.348	1.45	1.531	2.62
CONSTR	0	-10.484	0	0.046			
MANU	0	-10.484	0	0.07	1.17	1.251	2.336
TIMBER	0	-10.484	0	0.321	1.423	1.505	2.593
TCU	0	-10.484	0	0.119	1.219	1.3	2.387
TRADE	0	-10.484	0	1.14	2.251	2.333	3.43
FIRE	0	-10.484	0	0.26	1.362	1.443	2.531
SERVS	0	-10.484	0	-0.183	0.914	0.995	2.078
GOVT	0	-10.484	0	0.187	1.287	1.369	2.456
LASPEYRES	0	-10.5	0	0.1	1.4	1.5	2.6

F. OTHER SCALARS

CADEF	-4.171	FEDFLO	23.501	EDTRANS	74.349	CADJ	2.211
WSTAR	0	W	0	PP	2.129	RSTAR	
R		PROPY	2.129	CAPY	2.211	ENTY	0.539
DEPREC	2.211	RETEARN	0.539	EXOSAVE	-1.565	LTOT	0.827

education programs (G) decreased by 11.1% under neoclassical, and by 10.5% under Keynesian closures. Since revenues collected by the federal government increased while expenditures were fixed, the region's net contribution to the federal budget (FEDFLO) increased by 15.8% under neoclassical and by 23.5% under Keynesian closures.

For the three household categories, total income increased by 0.403%, 0.468% and 0.511% for low, medium and high income households, respectively, under neoclassical closure; and by 0.649%, 0.773% and 0.856%, respectively, under Keynesian closure. Disposable income increased by 0.849%, 0.869% and 1.902%, respectively, under neoclassical closure; and by 1.099%, 1.18% and 2.265%, respectively, under Keynesian closure. High income households received relatively more property tax relief than low or medium income households. Consequently HHY and HHYD increased proportionately more for high income households than for medium or low income households. Increases in total income and disposable income were greater under Keynesian than under neoclassical closure. Total labor utilization (LTOT) was 0.83% greater under Keynesian closure than under neoclassical closure (where labor supply is fixed).

Comparing Laspeyres quantity indices, each household category appeared slightly better off than was indicated by comparing disposable incomes. Improvement in Laspeyres quantity indices ranged from 1% to 2.1% under neoclassical closure, and from 1.4% to 2.6% under Keynesian closure, with high income households benefiting proportionately more than either low or medium income households.

Under both closures, the decline in government demand for goods and services was offset by increases in private consumption in all but two sectors, Construction and GOVT, as reflected by changes in total absorption (Q). Results for industry output (X), generally paralleled changes in Q. The corresponding prices for absorption (P) and for output (PX) moved slightly (i.e. not more than (+/-) 1.13%), and generally in the direction opposite to movements in Q and X, with the exception of Services under both closures and Construction and GOVT under Keynesian closure.

Demand for regional products (XXD) reflected changes in total absorption. The corresponding price for regional products (PD) generally moved in the opposite direction to XXD, with the exception of Services under both closures, where PD increased as did XXD, and

Construction under Keynesian closure where both decreased. Exports (E) increased for all sectors, with the exception of Construction and GOVT under both closures. With the exception of Services under both closures, and Construction and GOVT under Keynesian closure, exports moved in the opposite direction to PD. This pattern was repeated for imports with respect to PD, again with the exception of Services under both closures, and Construction and Government under Keynesian closure.

Substitution of labor for the other two factors was greater under Keynesian closure, where labor's marginal cost was held constant relative to the other factors. Changes in sector output were generally reflected by corresponding changes in utilization of the two intersectorally mobile factors (proprietors and labor), although exceptions to this are more numerous, especially under neoclassical closure, since factor movements are more constrained than in the previous case.

Scenario II: Balanced Budget Incidence With Fixed S/L Non-Education Spending

The treatment of state and local government sectors in this analysis is reversed compared with the previous section. Expenditures for non-education programs are now fixed while education spending responds directly to changes in education property tax revenues. Since under total non-education revenues increased while expenditures remained fixed, transfers from the non-education account (EDTRANS) to accommodate education spending increased relative to the baseline.

Aggregate results of this simulation are similar to scenario I, although there are significant intersectoral differences. Results under neoclassical CGE and Keynesian CGE closures and assumptions of mobile and fixed intersectoral capital endowment are presented below. Variables are expressed as percentage changes from base levels.

Mobile Intersectoral Capital (See Tables 8 and 9)

EDTRANS increased by 23.1% under neoclassical (Nm) and 26.1% under Keynesian (Km) CGE closures, reflecting the increase in non-education revenues relative to expenditures. Commodity purchases for state and local education programs (G) decreased by 20.8% under neoclassical, and by 19.45% under Keynesian closures. Since revenues collected by the federal government increased while expenditures were fixed, the region's

Table 8. BALANCED BUDGET SCENARIO II: FIXED S/L NON-ED. EXPENDITURE (Nm)
(NEOCLASSICAL CLOSURE; MOBILE INTERSECTORAL CAPITAL)

(% CHANGE)

A. SECTORAL FACTOR DEMANDS

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
LAB	4.27	-2.488	-0.287	0.804	0.79	1.689	2.151	0.764	-3.362
PROPR	2.982	-3.693	-1.518	-0.441	-0.455	0.433	0.89	-0.481	
CAP	3.257	-3.435	-1.255	-0.175	-0.189	0.702	1.159	-0.215	-4.301

B. SECTORAL PRICE AND QUANTITY RESULTS

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
P	-0.48	0.195	0.049	-0.084	-0.1	-0.931	-0.67	0.322	0.443
PD	-0.985	0.197	0.195	-0.117	-0.147	-1.028	-1.007	0.404	0.511
PX	-0.407	0.191	0.072	-0.037	-0.11	-0.832	-0.791	0.344	0.469
PV	1.093	0.732	0.712	0.731	0.975	0.63	1.012	0.812	0.506
Q	1.858	-2.743	-0.138	0.359	0.238	1.392	1.364	0.466	-3.368
X	3.614	-2.754	-0.54	0.53	0.272	1.514	1.59	0.408	-3.41
XXD	2.712	-2.746	-0.356	0.409	0.257	1.433	1.502	0.432	-3.394
E	4.249	-3.033	-0.646	0.586	0.316	1.854	1.914	0.27	-3.591
M	1.197	-2.459	-0.065	0.233	0.198	1.015	1.092	0.595	-3.197
ND	2.09	0.406	-0.079	0.265	0.389	0.014	1.133	0.265	0.651
LABY	4.746	-2.043	0.169	1.265	1.25	2.154	2.618	1.224	-2.921

C. GOVERNMENT SALES AND TAX REVENUES

	FED	NED	ED
SALES	0.689	0.571	
BUSTAXES		32.826	-61.901
EXCTAXES	1.414	1.362	
ITAXES	1.414	10.131	-61.901
PROTAXES		37.308	-59.35
INCTAXES	1.537	0.514	
HTAXES	1.537	7.146	-59.35
LAB TAX	0.457	0.457	
CAP TAX	1.442	1.442	

D. HOUSEHOLD INCOME AND SAVINGS

	LOW	MED	HI
Y	0.396	0.482	0.556
YD	0.842	0.884	1.949
S	0.842	0.884	1.949

E. REAL GOVERNMENT SPENDING, INVESTMENT AND HOUSEHOLD CONSUMPTION

	FED	NONED	ED	INVEST	CLOW	CMED	CHI
ANR	0	0	-20.83	1.232	1.328	1.37	2.441
CONSTR	0	0	-20.83	0.55			
MANU	0	0	-20.83	0.697	0.792	0.834	1.899
TIMBER	0	0	-20.83	0.83	0.926	0.968	2.035
TCU	0	0	-20.83	0.847	0.943	0.985	2.052
TRADE	0	0	-20.83	1.693	1.79	1.832	2.908
FIRE	0	0	-20.83	1.426	1.522	1.564	2.637
SERVS	0	0	-20.83	0.423	0.518	0.56	1.622
GOVT	0	0	-20.83	0.302	0.397	0.439	1.5
LASPEYRES	0	0	-20.83	0.7	1.1	1.1	2.1

F. OTHER SCALARS

CADEF	-2.288	FEDFLO	16.124	EDTRANS	23.104	CADJ	1.442
WSTAR	0.457	W	0.457	PP	1.713	RSTAR	1.442
R	1.442	PROPY	1.713	CAPY	1.442	ENTY	0.352
DEPREC	1.442	RETEARN	0.352	EXOSAVE	0	LTOT	04

Table 9. BALANCED BUDGET SCENARIO II: FIXED S/L NON-ED. EXPENDITURE (Km)
(KEYNESIAN CLOSURE; MOBILE INTERSECTORAL CAPITAL)

(% CHANGE)

A. SECTORAL FACTOR DEMANDS

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
LAB	5.588	-2.145	1.285	3.232	2.142	2.631	3.299	1.701	-2.789
PROPR	3.207	-4.351	-0.999	0.905	-0.161	0.317	0.97	-0.592	
CAP	3.232	-4.328	-0.975	0.929	-0.137	0.341	0.994	-0.568	-4.957

B. SECTORAL PRICE AND QUANTITY RESULTS

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
P	-0.479	0.048	-0.019	-0.435	-0.029	-1.154	-0.576	0.228	0.097
PD	-0.984	0.048	-0.075	-0.608	-0.043	-1.275	-0.866	0.287	0.112
PX	-0.406	0.047	-0.028	-0.19	-0.032	-1.031	-0.68	0.244	0.103
PV	1.225	0.527	0.576	0.604	1.154	0.37	1.272	0.683	0.114
Q	2.545	-2.655	0.548	1.704	0.966	2.1	1.806	1.052	-2.89
X	4.311	-2.658	0.705	2.613	0.976	2.252	2.001	1.011	-2.9
XXD	3.404	-2.655	0.633	1.969	0.972	2.152	1.925	1.028	-2.896
E	4.949	-2.726	0.747	2.906	0.989	2.677	2.28	0.913	-2.94
M	1.881	-2.585	0.519	1.041	0.954	1.629	1.571	1.144	-2.853
ND	2.949	1.099	0.886	1.86	1.393	0.902	1.735	0.955	1.522
LABY	5.588	-2.145	1.285	3.232	2.142	2.631	3.299	1.701	-2.789

C. GOVERNMENT SALES AND TAX REVENUES

	FED	NED	ED
SALES	1.342	1.111	
BUSTAXES		32.826	-61.901
EXCTAXES	2.063	2.095	
ITAXES	2.063	10.66	-61.901
PROTAXES		37.308	-59.35
INCTAXES	2.032	0.985	
HTAXES	2.032	7.532	-59.35
LAB TAX	1.071	1.071	
CAP TAX	2.282	2.282	

D. HOUSEHOLD INCOME AND SAVINGS

	LOW	MED	HI
Y	0.758	0.927	1.055
YD	1.21	1.336	2.474
S	1.21	1.336	2.474

E. REAL GOVERNMENT SPENDING, INVESTMENT AND HOUSEHOLD CONSUMPTION

	FED	NONED	ED	INVEST	CLOW	CMED	CHI
ANR	0	0	-19.455	0.481	1.697	1.824	2.968
CONSTR	0	0	-19.455	-0.048			
MANU	0	0	-19.455	0.019	1.229	1.355	2.494
TIMBER	0	0	-19.455	0.437	1.652	1.779	2.922
TCU	0	0	-19.455	0.029	1.24	1.366	2.504
TRADE	0	0	-19.455	1.168	2.392	2.519	3.671
FIRE	0	0	-19.455	0.579	1.796	1.923	3.068
SERVS	0	0	-19.455	-0.228	0.979	1.105	2.241
GOVT	0	0	-19.455	-0.097	1.112	1.238	2.375
LASPEYRES	0	0	-19.455	0.1	1.5	1.7	2.8

F. OTHER SCALARS

CADEF	-4.593	FEDFLO	26.881	EDTRANS	26.142	CADJ	2.282
WSTAR	0	W	0	PP	2.307	RSTAR	2.282
R	2.282	PROPY	2.307	CAPY	2.282	ENTY	0.556
DEPREC	2.282	RETEARN	0.556	EXOSAVE	-1.717	LTOT	1.071

net contribution to the federal budget (FEDFLO) increased by 16.1% under neoclassical and by 26.9% under Keynesian closures.

For the three household categories, total income increased by 0.396%, 0.482% and 0.556% for low, medium and high income households, respectively, under neoclassical closure; and by 0.758%, 0.927% and 1.055%, respectively, under Keynesian closure. Disposable income increased by 0.842%, 0.884% and 1.949%, respectively, under neoclassical closure; and by 1.21%, 1.336% and 2.474%, respectively, under Keynesian closure. High income households received relatively more property tax relief than low or medium income households. Consequently HHY and HHYD increased proportionately more for high income households than for medium or low income households. Total labor utilization (LTOT) was 1.07% greater under Keynesian closure than under neoclassical closure (where labor supply is fixed).

Comparing Laspeyres quantity indices, each household category again appeared better off than by comparison of disposable incomes. Improvement ranged from 1.1% to 2.1% under neoclassical closure, and from 1.5% to 2.8% under Keynesian closure, with high income households benefiting proportionately more than the other two household categories.

In this scenario, Manufacturing under neoclassical closure is added to the list of sectors (along with Construction and GOVT) where increased private consumption fails to offset the decline in government demand as reflected by changes in total absorption (Q). The decline in Construction is greater, and in GOVT less, than was exhibited in scenario I due to the relatively different distribution of expenditures between the two state and local government sectors. Results for industry output (X) paralleled changes in Q. The corresponding prices for commodities (P) and for output (PX) changed slightly (i.e. not more than (+/-) 1.15%), and generally in the direction opposite to movements in Q and X, with the exception of Services under both closures, where P and PX both increased along with Q and X.

Demand for regional products (XXD) mirrored the changes in total absorption for all sectors. The corresponding price for regional products (PD) generally moved in the opposite direction to XXD, with the exception of Services under both closures, where PD increased as did XXD. Exports (E) increased for all sectors, with the exception of Construction and GOVT under both closures, and Manufacturing under neoclassical closure. Except for Services under both closures, exports moved in the opposite direction to PD. This pattern was repeated for imports with respect to PD.

Substitution of labor for the other two factors was again much greater under Keynesian closure. Changes in utilization of all three factors (labor, proprietors and capital) generally corresponded to the direction of change in sector output. Exceptions to this again include Services and TCU under both closures, Manufacturing under Keynesian closure and Timber under neoclassical closure. In these cases utilization of proprietors' and capital services decreased although output increased.

__Fixed Intersectoral Capital (See Tables 10 and 11)__

Transfers from the non-education account (EDTRANS) to accommodate education spending increased by 23.5% under neoclassical (Nf) and by 26.35% under Keynesian (Kf) CGE closures. Commodity purchases for state and local education programs (G) decreased by 20.6% under neoclassical, and by 19.3% under Keynesian closures. Since revenues collected by the federal government increased while expenditures were fixed, the region's net contribution to the federal budget (FEDFLO) increased by 16.3% under neoclassical and by 25.2% under Keynesian closures.

For the three household categories, total income increased by 0.399%, 0.479% and 0.544% for low, medium and high income households, respectively, under neoclassical closure; and by 0.683%, 0.831% and 0.941%, respectively, under Keynesian closure. Disposable income increased by 0.845%, 0.881% and 1.938%, respectively, under neoclassical closure; and by 1.133%, 1.238% and 2.354%, respectively, under Keynesian closure. High income households received relatively more property tax relief than low or medium income households. Consequently HHY and HHYD increased proportionately more for high income households than for medium or low income households. Increases in total income and disposable income were greater under Keynesian than under neoclassical closure. Total labor utilization (LTOT) was 0.948% greater under Keynesian closure than under neoclassical closure (where labor supply is fixed).

Comparing Laspeyres quantity indices, each household category again appeared better off than by comparison of disposable incomes. Improvement ranged from 1% to 2.1% under neoclassical closure, and from

Table 10. BALANCED BUDGET SCENARIO II: FIXED S/L NON-ED. EXPENDITURE (Nf)
(NEOCLASSICAL CLOSURE; FIXED INTERSECTORAL CAPITAL)

(% CHANGE)

A. SECTORAL FACTOR DEMAND

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
LAB	3.6	-2.651	0.125	0.89	0.725	1.693	2.477	0.699	-3.496
PROPR	2.502	-3.683	-0.936	-0.179	-0.343	0.615	1.391	-0.368	

B. SECTORAL PRICE AND QUANTITY RESULTS

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
P	-0.321	0.105	-0.01	-0.106	-0.154	-0.847	-0.266	0.311	0.249
PD	-0.66	0.106	-0.041	-0.148	-0.226	-0.936	-0.4	0.39	0.287
PX	-0.273	0.103	-0.015	-0.046	-0.168	-0.757	-0.314	0.331	0.264
PV	1.358	0.521	0.521	0.714	0.863	0.713	1.833	0.763	0.287
Q	1.525	-2.696	-0.013	0.427	0.279	1.335	1.015	0.46	-3.298
X	2.691	-2.702	0.073	0.644	0.331	1.446	1.104	0.404	-3.322
XXD	2.093	-2.698	0.033	0.49	0.308	1.373	1.069	0.427	-3.313
E	3.112	-2.852	0.095	0.714	0.399	1.755	1.231	0.271	-3.423
M	1.085	-2.544	-0.029	0.268	0.217	0.992	0.907	0.584	-3.202
ND	1.665	0.281	0.095	0.344	0.423	0.049	0.872	0.231	0.606
LABY	4.085	-2.195	0.595	1.363	1.197	2.169	2.957	1.171	-3.044
R, RSTAR	4.085	-2.195	0.595	1.363	1.197	2.169	2.957	1.171	-3.044

C. GOVERNMENT SALES AND TAX REVENUES

	FED	NED	ED
SALES	0.682	0.571	
BUSTAXES		32.826	-61.901
EXCTAX	1.14	1.162	
ITAXES	1.14	9.987	-61.901
PROTAXES		37.308	-59.35
INCTAX	1.529	0.506	
HTAXES	1.529	7.14	-59.35
LAB	0.469	0.469	
CAP	1.557	1.557	

D. HOUSEHOLD INCOME AND SAVINGS

	LOW	MED	HI
Y	0.399	0.479	0.544
YD	0.845	0.881	1.938
S	0.845	0.881	1.938

E. REAL GOVERNMENT SPENDING, INVESTMENT AND HOUSEHOLD CONSUMPTION

	FED	NONED	ED	INVEST	CLOW	CMED	CHI
ANR	0	0	-20.587	1.066	1.169	1.206	2.266
CONSTR	0	0	-20.587	0.637			
MANU	0	0	-20.587	0.752	0.855	0.892	1.948
TIMBER	0	0	-20.587	0.849	0.951	0.988	2.045
TCU	0	0	-20.587	0.897	1	1.037	2.095
TRADE	0	0	-20.587	1.603	1.706	1.743	2.809
FIRE	0	0	-20.587	1.011	1.114	1.15	2.21
SERVS	0	0	-20.587	0.43	0.532	0.569	1.622
GOVT	0	0	-20.587	0.492	0.594	0.631	1.685
LASPEYRES	0	0	-20.6	0.7	1	1.1	2.1

F. OTHER SCALARS

CADEF	-2.37	FEDFLO	16.303	EDTRANS	23.494	CADJ	1.557
WSTAR	0.469	W	0.469	PP	1.545	RSTAR	
R		PROPY	1.545	CAPY	1.557	ENTY	0.38
DEPREC	1.557	RETEARN	0.38	EXOSAVE	0	LTOT	0

Table 11. BALANCED BUDGET SCENARIO II: FIXED S/L NON-ED. EXPENDITURE (Kf)
(KEYNESIAN CLOSURE; FIXED INTERSECTORAL CAPITAL)

(% CHANGE)

A. SECTORAL FACTOR DEMAND

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
LAB	4.972	-2.372	1.616	2.751	1.923	2.53	3.483	1.54	-2.986
PROPR	2.867	-4.33	-0.422	0.69	-0.121	0.474	1.407	-0.497	

B. SECTORAL PRICE AND QUANTITY RESULTS

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
P	-0.357	-0.08	-0.075	-0.326	-0.127	-1.131	-0.269	0.169	-0.142
PD	-0.734	-0.081	-0.296	-0.456	-0.186	-1.249	-0.404	0.212	-0.164
PX	-0.303	-0.078	-0.108	-0.143	-0.138	-1.01	-0.317	0.18	-0.151
PV	1.451	0.24	0.418	0.693	0.981	0.385	1.914	0.573	-0.154
Q	2.165	-2.611	0.573	1.366	0.89	1.987	1.449	0.992	-2.85
X	3.471	-2.606	1.193	2.044	0.933	2.137	1.54	0.961	-2.836
XXD	2.802	-2.609	0.909	1.564	0.914	2.038	1.504	0.974	-2.841
E	3.943	-2.492	1.358	2.263	0.989	2.552	1.669	0.888	-2.778
M	1.672	-2.727	0.461	0.87	0.839	1.527	1.34	1.059	-2.905
ND	2.476	0.905	0.937	1.48	1.257	0.803	1.446	0.848	1.355
LABY	4.972	-2.372	1.616	2.751	1.923	2.53	3.483	1.54	-2.986
R, RSTAR	4.972	-2.372	1.616	2.751	1.923	2.53	3.483	1.54	-2.986

C. GOVERNMENT SALES AND TAX REVENUES

	FED	NED	ED
SALES	1.216	0.985	
BUSTAXES		32.826	-61.901
EXCTAX	1.753	1.838	
ITAXES	1.753	10.475	-61.901
PROTAXES		37.308	-59.35
INCTAX	1.921	0.879	
HTAXES	1.921	7.446	-59.35
LAB	0.948	0.948	
CAP	2.232	2.232	

D. HOUSEHOLD INCOME AND SAVINGS

	LOW	MED	HI
Y	0.683	0.831	0.941
YD	1.133	1.238	2.354
S	1.133	1.238	2.354

E. REAL GOVERNMENT SPENDING, INVESTMENT AND HOUSEHOLD CONSUMPTION

	FED	NONED	ED	INVEST	CLOW	CMED	CHI
ANR	0	0	-19.255	0.358	1.495	1.601	2.721
CONSTR	0	0	-19.255	0.08			
MANU	0	0	-19.255	0.075	1.209	1.314	2.431
TIMBER	0	0	-19.255	0.327	1.464	1.57	2.689
TCU	0	0	-19.255	0.127	1.261	1.367	2.484
TRADE	0	0	-19.255	1.144	2.29	2.396	3.524
FIRE	0	0	-19.255	0.269	1.406	1.511	2.63
SERVS	0	0	-19.255	-0.169	0.963	1.067	2.181
GOVT	0	0	-19.255	0.143	1.277	1.383	2.5
LASPEYRES	0	0	-19.3	0.1	1.4	1.5	2.7

F. OTHER SCALARS

CADEF	-4.365	FEDFLO	25.169	EDTRANS	26.346	CADJ	2.232
WSTAR	0	W	0	PP	2.046	RSTAR	
R		PROPY	2.046	CAPY	2.232	ENTY	0.544
DEPREC	2.232	RETEARN	0.544	EXOSAVE	-1.628	LTOT	0.948

1.4% to 2.7% under Keynesian closure, with high income households benefiting proportionately more than the other two household categories.

Manufacturing under neoclassical closure is added to Construction and GOVT under both closures where increased private consumption fails to offset the decline in government demand as reflected by changes in total absorption (Q). The decline in Construction is greater, and in GOVT less, than was exhibited in scenario I due to the relatively different distribution of expenditures between the two state and local government sectors. Results for industry output (X) paralleled changes in Q with the exception of Manufacturing under neoclassical closure. The corresponding prices for commodities (P) and for output (PX) changed slightly (i.e. not more than (+/-) 1.13%), and generally in the direction opposite to movements in Q and X, with the exception of Services under both closures, where P and PX both increased along with Q and X, GOVT under Keynesian closure where P and PX both decreased along with Q and X, and Manufacturing under neoclassical closure where P and Q both decreased.

Demand for regional products (XXD) mirrored the changes in total absorption for all sectors with the exception of Manufacturing under neoclassical closure. The corresponding price for regional products (PD) generally moved in the opposite direction to XXD, with the exception of Services under both closures, where PD increased as did XXD, and Construction and GOVT under Keynesian closure, where both PD and XXD decreased. Exports (E) increased for all sectors, with the exception of Construction and GOVT under both closures. Except for Services under both closures and Construction and GOVT under Keynesian closure, exports moved in the opposite direction to PD. This pattern was generally repeated for imports with respect to PD, with the addition of Manufacturing under neoclassical closure.

Compared with scenario I (i.e. holding education programs harmless), reducing state and local education expenditures under scenario II produced a slightly different pattern of impacts. Reductions in absorption and output of GOVT services were generally less severe under scenario II, while reductions in Construction were more pronounced. Other sectors displayed generally larger increases (smaller decreases) in absorption and output under scenario I, with the exception of ANR under all four variants (Nm, Nf, Km, Kf); and Timber, TCU and Trade under variants Km and Kf.

Under **neoclassical** closures (i.e. variants Nf and Nm), low income households paid slightly more state income tax under scenario I than under scenario II. However, total state income taxes increased more under scenario II due to relatively higher payments by medium and high income groups. Low income households had slightly higher total income and disposable income under scenario I. For medium and high income households this pattern was reversed: both appeared better off under scenario II. Laspeyres quantity indicators, however, showed no difference in relative purchasing power between the two simulations.

Under **Keynesian** closures (i.e. variants Kf and Km), total state income tax collections increased more under scenario II due to relatively higher state income tax payments by all income groups. All household groups appeared relatively better off under scenario II comparing any of the three household indicators (i.e. total income, disposable income, and Laspeyres index).

With the exception of the neoclassical variants under scenario I, all household groups appeared better off under scenario II. The relatively higher income for low income households under neoclassical variants of scenario I results from the combined effects of regional industries' response to the different mixes of regional demands given relatively constrained labor substitution possibilities.

Scenario III: Differential Incidence With Endogenous State Income Tax Rate

This simulation is conceptually different than the two cases discussed above, and differences between the two closures are also most pronounced. For this analysis, all government expenditures were fixed in real terms. The average state income tax rate paid by high income households was allowed to adjust endogenously in order to recover sufficient revenues to maintain real baseline levels of state and local government expenditure. Results of this simulation under neoclassical CGE and Keynesian CGE closures and assumptions of mobile and fixed intersectoral capital endowment are presented below. Variables are expressed as percentage changes from base levels.

Mobile Intersectoral Capital (See Tables 12 and 13)

Under Keynesian closure (Km), changes in output and absorption are uniformly positive and no smaller than 0.247%. Under neoclassical

Table 12. DIFFERENTIAL TAX INCIDENCE SCENARIO III: REVENUE NEUTRAL (Nm) (NEOCLASSICAL CLOSURE; MOBILE INTERSECTORAL CAPITAL)

(% CHANGE)

A. SECTORAL FACTOR DEMANDS

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
LAB	3.339	-0.488	-0.834	-0.019	0.184	0.366	1.235	-0.494	-0.188
PROPR	2.826	-0.982	-1.326	-0.516	-0.313	-0.132	0.733	-0.988	
CAP	2.981	-0.833	-1.178	-0.366	-0.163	0.019	0.884	-0.839	-0.534

B. SECTORAL PRICE AND QUANTITY RESULTS

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
P	-0.551	0.224	0.068	-0.014	-0.162	-0.824	-0.722	0.325	0.602
PD	-1.13	0.227	0.267	-0.019	-0.238	-0.911	-1.086	0.408	0.694
PX	-0.466	0.22	0.098	-0.006	-0.177	-0.737	-0.853	0.347	0.638
PV	0.921	0.78	0.764	0.772	0.86	0.737	0.87	0.811	0.69
Q	1.08	-0.581	-0.376	-0.147	-0.058	0.195	0.793	-0.574	-0.146
X	3.084	-0.594	-0.925	-0.119	-0.003	0.302	1.036	-0.631	-0.205
XXD	2.053	-0.585	-0.674	-0.139	-0.028	0.232	0.941	-0.607	-0.183
E	3.809	-0.922	-1.071	-0.11	0.068	0.599	1.383	-0.769	-0.459
M	0.328	-0.247	-0.275	-0.168	-0.123	-0.134	0.501	-0.445	0.094
ND	1.531	0.299	-0.223	-0.036	0.079	0.009	0.522	-0.057	0.111
LABY	4.033	0.181	-0.168	0.652	0.857	1.041	1.915	0.175	0.483

C. GOVERNMENT SALES AND TAX REVENUES

	FED	NED	ED
SALES	-0.04	-0.357	
BUSTAXES		32.826	-61.901
EXCTAXES	0.728	0.627	
ITAXES	0.728	9.601	-61.901
PROTAXES		37.308	-59.35
INCTAXES	1.609	40.565	
HTAXES	1.609	39.977	-59.35
LAB TAX	0.672	0.672	
CAP TAX	1.022	1.022	

D. HOUSEHOLD INCOME, SAVINGS AND AVERAGE STATE INCOME TAX RATES

	LOW	MED	HI
Y	0.413	0.533	0.636
YD	0.859	0.935	-3.943
S	0.859	0.935	-3.943
TAX RATES	0	0	62.32

E. REAL GOVERNMENT SPENDING, INVESTMENT AND HOUSEHOLD CONSUMPTION

	FED	NONED	ED	INVEST	LOW	MED	HI
ANR	0	0	0	-0.697	1.417	1.494	-3.411
CONSTR	0	0	0	-1.465			
MANU	0	0	0	-1.311	0.791	0.867	-4.008
TIMBER	0	0	0	-1.231	0.873	0.949	-3.93
TCU	0	0	0	-1.084	1.023	1.099	-3.787
TRADE	0	0	0	-0.423	1.697	1.774	-3.145
FIRE	0	0	0	-0.526	1.592	1.669	-3.245
SERVS	0	0	0	-1.564	0.532	0.608	-4.254
GOVT	0	0	0	-1.835	0.255	0.331	-4.518
LASPEYRES	0	0	0	-1.3	1.1	1.2	-3.8

F. OTHER SCALARS

CADEF	-2.039	FEDFLO	16.038	EDTRANS	75.415	CADJ	1.022
WSTAR	0.672	W	0.672	PP	1.174	RSTAR	1.022
R	1.022	PROPY	1.174	CAPY	1.022	ENTY	0.249
DEPREC	1.022	RETEARN	0.249	EXOSAVE	0	LTOT	0

Table 13. DIFFERENTIAL TAX INCIDENCE SCENARIO III: REVENUE NEUTRAL (Km) (KEYNESIAN CLOSURE; MOBILE INTERSECTORAL CAPITAL)

(% CHANGE)

A. SECTORAL FACTOR DEMANDS

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
LAB	5.073	0.785	1.547	3.427	2.313	1.996	3.098	1.132	0.367
PROPR	2.78	-1.414	-0.669	1.17	0.08	-0.229	0.848	-1.075	
CAP	2.633	-1.555	-0.811	1.025	-0.063	-0.372	0.704	-1.217	-1.964

B. SECTORAL PRICE AND QUANTITY RESULTS

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
P	-0.466	0.051	-0.008	-0.379	-0.008	-1.127	-0.544	0.229	0.102
PD	-0.958	0.051	-0.032	-0.529	-0.011	-1.244	-0.817	0.288	0.118
PX	-0.395	0.05	-0.012	-0.166	-0.009	-1.007	-0.642	0.245	0.108
PV	1.206	0.518	0.596	0.621	1.19	0.377	1.322	0.673	0.119
Q	2.111	0.268	0.878	1.995	1.107	1.465	1.569	0.498	0.257
X	3.821	0.265	0.946	2.789	1.11	1.613	1.753	0.456	0.247
XXD	2.943	0.267	0.914	2.227	1.109	1.515	1.681	0.474	0.251
E	4.44	0.19	0.964	3.044	1.113	2.025	2.015	0.358	0.204
M	1.468	0.345	0.865	1.417	1.104	1.008	1.347	0.589	0.298
ND	2.697	1.35	1.304	2.284	1.594	1.458	1.515	1.145	1.463
LABY	5.073	0.785	1.547	3.427	2.313	1.996	3.098	1.132	0.367

C. GOVERNMENT SALES AND TAX REVENUES

	FED	NED	ED
SALES	1.097	0.677	
BUSTAXES		32.826	-61.901
EXCTAXES	1.782	1.801	
ITAXES	1.782	10.448	-61.901
PROTAXES		37.308	-59.35
INCTAXES	2.426	37.284	
HTAXES	2.426	37.288	-59.35
LAB TAX	1.675	1.675	
CAP TAX	2.377	2.377	

D. HOUSEHOLD INCOME, SAVINGS AND AVERAGE STATE INCOME TAX RATES

	LOW	MED	HI
Y	1.012	1.268	1.46
YD	1.468	1.681	-2.471
S	1.468	1.681	-2.471
TAX RATES	0	0	55.07

E. REAL GOVERNMENT SPENDING, INVESTMENT AND HOUSEHOLD CONSUMPTION

	FED	NONED	ED	INVEST	CLOW	CMED	CHI
ANR	0	0	0	0.468	1.943	2.157	-2.014
CONSTR	0	0	0	-0.051			
MANU	0	0	0	0.008	1.476	1.689	-2.463
TIMBER	0	0	0	0.38	1.854	2.067	-2.100
TCU	0	0	0	0.008	1.697	1.774	-3.145
TRADE	0	0	0	1.14	2.625	2.84	-1.359
FIRE	0	0	0	0.547	2.023	2.237	-1.938
SERVS	0	0	0	-0.229	1.236	1.449	-2.694
GOVT	0	0	0	-0.102	1.365	1.577	-2.57
LASPEYRES	0	0	0	0.1	1.8	2.0	-2.2

F. OTHER SCALARS

CADEF	-3.809	FEDFLO	33.527	EDTRANS	74.745	CADJ	2.377
WSTAR	0	W	0	PP	2.231	RSTAR	2.377
R	2.377	PROPY	2.231	CAPY	2.377	ENTY	0.579
DEPREC	2.377	RETEARN	0.579	EXOSAVE	1.198	LTOT	1.675

closure (Nm), only ANR, Trade and FIRE increase while output and absorption both decline for the other six sectors.

For the three household categories, total income increased by 0.413%, 0.533% and 0.636% for low, medium and high income households, respectively, under neoclassical closure; and by 1.012%, 1.268% and 1.46%, respectively, under Keynesian closure. Disposable income changed by 0.859%, 0.935% and -3.943%, respectively, under neoclassical closure; and by 1.468%, 1.681% and -2.471%, respectively, under Keynesian closure. The fall in disposable incomes for high income households was due to higher average state income tax rates. Increases in total income for low and medium income groups were more than double under Keynesian closure than under neoclassical closure. Disposable incomes for low and medium income households increased by at least 70% more under Keynesian closure. For high income households, the fall in disposable incomes was 37% less severe under Keynesian closure.

Total state household income taxes increased 3.28 percentage points more under neoclassical closure due to the higher rate on high income households. Industry excise taxes were greater under Keynesian closure than under neoclassical closure due to the relatively greater expansion of output under the former. Total labor utilization (LTOT) was 1.675% greater under Keynesian closure.

Property tax relief under Measure 5 conferred relatively greater windfall benefits to high income households. However this was more than completely reversed by the higher state income tax rate. In the baseline scenario, average state income tax rates were 2.1%, 2.3% and 6.9% of state-taxable income for low, medium and high income households, respectively. In order to replace lost property tax revenues, average state income tax rates on high income households increased by 62% under neoclassical closure, and by 55% under Keynesian closure, to 11.2% and 10.7%, respectively, of state-taxable income (Note: These results also hold under the assumption of fixed intersectoral capital, below).

Comparing Laspeyres quantity indices, each household category again appeared slightly better off than comparison of disposable incomes would indicate. Improvements for low and medium income households were 1.1% and 1.2%, respectively under neoclassical closure; and 1.8% and 2%, respectively, under Keynesian closure. High income households were worse off under neoclassical closure (-3.8%) than under Keynesian closure (-2.2%).

Fixed Intersectoral Capital (See Tables 14 and 15)

Under Keynesian closure (Kf), changes in output and absorption are uniformly positive and no smaller than 0.242%. Under neoclassical closure (Nf) output and absorption both increase for only ANR, Trade and FIRE while output and absorption both decline for Construction, Manufacturing, Services and GOVT.

For the three household categories, total income increased by 0.427%, 0.545% and 0.644% for low, medium and high income households, respectively, under neoclassical closure; and by 0.943%, 1.181% and 1.359%, respectively, under Keynesian closure. Disposable income changed by 0.873%, 0.948% and -3.939%, respectively, under neoclassical closure; and by 1.397%, 1.593% and -2.569%, respectively, under Keynesian closure. The fall in disposable incomes for high income households was due to higher average state income tax rates.

Total state household income taxes increased more under neoclassical closure due to the higher rate on high income households. Industry excise taxes increased more under Keynesian closure due to the relatively greater expansion of output. Total labor utilization (LTOT) was 1.56% greater under Keynesian closure.

Property tax relief conferred relatively greater windfall benefits to high income households under Measure 5. However this was more than completely reversed by the higher state income tax rate. In the baseline scenario, average state income tax rates were 2.1%, 2.3% and 6.9% of state-taxable income for low, medium and high income households, respectively. In order to replace lost property tax revenues, average state income tax rates on high income households increased by 62% under neoclassical closure, and by 55% under Keynesian closure, to 11.2% and 10.7%, respectively, of state-taxable income.

Comparing Laspeyres quantity indices, each household category again appeared slightly better off than comparison of disposable incomes would indicate. Improvements for low and medium income households were 1% and 1.1%, respectively under neoclassical closure; and 1.7% and 1.9%, respectively, under Keynesian closure. High income households were worse off under neoclassical closure (-3.8%) than under Keynesian closure (-2.3%).

Table 14. DIFFERENTIAL TAX INCIDENCE SCENARIO III: REVENUE NEUTRAL (Nf) (NEOCLASSICAL CLOSURE; FIXED INTERSECTORAL CAPITAL)

(% CHANGE)

A. SECTORAL FACTOR DEMAND

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
LAB	2.696	-0.574	-0.508	0.082	0.116	0.335	1.466	-0.581	-0.219
PROPR	2.371	-0.889	-0.822	-0.235	-0.201	0.018	1.145	-0.896	

B. SECTORAL PRICE AND QUANTITY RESULTS

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
P	-0.399	0.196	0.015	-0.051	-0.195	-0.786	-0.401	0.298	0.608
PD	-0.82	0.198	0.061	-0.071	-0.286	-0.868	-0.604	0.375	0.701
PX	-0.339	0.193	0.022	-0.022	-0.213	-0.702	-0.474	0.319	0.644
PV	1.177	0.735	0.596	0.741	0.782	0.762	1.514	0.74	0.697
Q	0.778	-0.59	-0.271	-0.054	-0.024	0.18	0.526	-0.56	-0.148
X	2.22	-0.601	-0.397	0.049	0.043	0.281	0.66	-0.613	-0.208
XXD	1.48	-0.593	-0.339	-0.024	0.013	0.214	0.608	-0.591	-0.185
E	2.741	-0.888	-0.43	0.082	0.128	0.564	0.852	-0.739	-0.463
M	0.234	-0.297	-0.248	-0.13	-0.101	-0.134	0.364	-0.442	0.094
ND	1.141	0.197	-0.077	0.068	0.114	0.034	0.319	-0.08	0.088
LABY	3.423	0.129	0.197	0.79	0.825	1.046	2.185	0.123	0.488
R, RSTAR	3.423	0.129	0.197	0.79	0.825	1.046	2.185	0.123	0.488

C. GOVERNMENT SALES AND TAX REVENUES

	FED	NED	ED
SALES	-0.028	-0.355	
BUSTAXES		32.826	-61.901
EXCTAX	0.518	0.475	
ITAXES	0.518	9.491	-61.901
PROTAXES		37.308	-59.35
INCTAX	1.619	40.599	
HTAXES	1.619	40.006	-59.35
LAB	0.708	0.708	
CAP	1.126	1.126	

D. HOUSEHOLD INCOME, SAVINGS AND AVERAGE STATE INCOME TAX RATES

	LOW	MED	HI
Y	0.427	0.545	0.644
YD	0.873	0.948	-3.939
S	0.873	0.948	-3.939
TAX RATES	0	0	62.32

E. REAL GOVERNMENT SPENDING, INVESTMENT AND HOUSEHOLD CONSUMPTION

	FED	NONED	ED	INVEST	CLOW	CMED	CHI
ANR	0	0	0	-0.846	1.277	1.352	-3.554
CONSTR	0	0	0	-1.435			
MANU	0	0	0	-1.257	0.857	0.932	-3.954
TIMBER	0	0	0	-1.192	0.924	0.999	-3.89
TCU	0	0	0	-1.049	1.07	1.145	-3.751
TRADE	0	0	0	-0.46	1.672	1.747	-3.178
FIRE	0	0	0	-0.844	1.28	1.355	-3.552
SERVS	0	0	0	-1.536	0.573	0.647	-4.225
GOVT	0	0	0	-1.838	0.264	0.338	-4.519
LASPEYRES	0	0	0	-1.3	1	1.1	-3.8

F. OTHER SCALARS

CADEF	-2.117	FEDFLO	16.236	EDTRANS	75.387	CADJ	1.126
WSTAR	0.708	W	0.708	PP	1.028	RSTAR	
R		PROPY	1.028	CAPY	1.126	ENTY	0.274
DEPREC	1.126	RETEARN	0.274	EXOSAVE	0	LTOT	0

Table 15. DIFFERENTIAL TAX INCIDENCE SCENARIO III: REVENUE NEUTRAL (Kf) (KEYNESIAN CLOSURE; FIXED INTERSECTORAL CAPITAL)

(% CHANGE)

A. SECTORAL FACTOR DEMAND

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
LAB	4.603	0.658	1.829	2.886	2.125	1.88	3.21	0.968	0.255
PROPR	2.542	-1.324	-0.177	0.86	0.113	-0.127	1.177	-1.02	

B. SECTORAL PRICE AND QUANTITY RESULTS

	ANR	CONSTR	MANU	TIMBER	TCU	TRADE	FIRE	SERVS	GOVT
P	-0.373	-0.019	-0.057	-0.255	-0.08	-1.17	-0.332	0.143	0.006
PD	-0.767	-0.019	-0.223	-0.357	-0.117	-1.292	-0.5	0.18	0.006
PX	-0.317	-0.019	-0.082	-0.112	-0.087	-1.045	-0.393	0.153	0.006
PV	1.39	0.392	0.466	0.72	1.065	0.311	1.767	0.525	0.013
Q	1.806	0.264	0.888	1.619	1.021	1.41	1.306	0.466	0.243
X	3.168	0.266	1.357	2.151	1.048	1.564	1.418	0.441	0.242
XXD	2.47	0.265	1.142	1.775	1.036	1.462	1.375	0.451	0.242
E	3.661	0.293	1.481	2.322	1.083	1.992	1.578	0.379	0.24
M	1.293	0.236	0.803	1.23	0.989	0.936	1.172	0.524	0.245
ND	2.319	1.19	1.335	1.859	1.456	1.356	1.303	1.06	1.32
LABY	4.603	0.658	1.829	2.886	2.125	1.88	3.21	0.968	0.255
R,RSTAR	4.603	0.658	1.829	2.886	2.125	1.88	3.21	0.968	0.255

C. GOVERNMENT SALES AND TAX REVENUES

	FED	NED	ED
SALES	0.986	0.55	
BUSTAXES		32.826	-61.901
EXCTAX	1.555	1.612	
ITAXES	1.555	10.311	-61.901
PROTAXES		37.308	-59.35
INCTAX	2.327	37.132	
HTAXES	2.327	37.164	-59.35
LAB	1.564	1.564	
CAP	2.312	2.312	

D. HOUSEHOLD INCOME, SAVINGS AND AVERAGE STATE INCOME TAX RATES

	LOW	MED	HI
Y	0.943	1.181	1.359
YD	1.397	1.593	-2.569
S	1.397	1.593	-2.569
TAX RATES	0	0	55.07

E. REAL GOVERNMENT SPENDING, INVESTMENT AND HOUSEHOLD CONSUMPTION

	FED	NONED	ED	INVEST	CLOW	CMED	CHI
ANR	0	0	0	0.375	1.777	1.974	-2.204
CONSTR	0	0	0	0.019			
MANU	0	0	0	0.057	1.455	1.651	-2.514
TIMBER	0	0	0	0.256	1.657	1.853	-2.319
TCU	0	0	0	0.08	1.478	1.674	-2.491
TRADE	0	0	0	1.184	2.598	2.796	-1.415
FIRE	0	0	0	0.333	1.735	1.932	-2.244
SERVS	0	0	0	-0.143	1.252	1.448	-2.708
GOVT	0	0	0	-0.006	1.392	1.587	-2.574
LASPEYRES	0	0	0	0.1	1.7	1.9	-2.3

F. OTHER SCALARS

CADEF	-3.58	FEDFLO	31.82	EDTRANS	74.563	CADJ	2.312
WSTAR	0	W	0	PP	2.009	RSTAR	
R		PROPY	2.009	CAPY	2.312	ENTY	0.564
DEPREC	2.312	RETEARN	0.564	EXOSAVE	1.272	LTOT	1.564

CHAPTER 5

SUMMARY AND CONCLUSIONS

Tax and budget incidence, defined as the distribution of economic impact resulting from changes in government fiscal policy, is one of the most important but least understood aspects of state and local government policy analysis. Decisions made at state and local levels can have significant influence on the distribution of income and resources in the region. Until recently, theoretically consistent general equilibrium methods for examining regional incidence questions were largely beyond reach, largely due to the demanding data requirements. In support of this, Dervis, de Melo and Robinson observed that "(c)onstructing a consistent data base for an economy-wide model is a nightmare with which every model builder is all too familiar". The emergence of IMPLAN as a source of regional economic data, and the development of GAMS and other accessible numeric solution algorithms, have greatly facilitated building and applying complex CGE models to analyze relevant regional policy issues.

In this paper, I have introduced a CGE model of the Oregon economy, and demonstrated application of the model to analyze various aspects of an important regional policy issue: the impact of property tax reduction under Ballot Measure 5 on the state economy. The approach I have used borrows directly from public finance theory, specifically with respect to the total incidence of tax and budget policies. I have presented plausible estimates of economic adjustment to some alternative policy prescriptions under several transparent modeling assumptions. In particular, I examined the effect of diverting the direct impact of Measure 5 budget restrictions to education versus non-education programs; as well as the effect of fully replacing lost property tax revenue with an increased tax on the income of "high" income households. Each scenario was replicated under different polar assumptions regarding the elasticities of regional labor supply and of extra-regional financial inflows.

The results of these simulations indicate some interesting points. The different distribution of expenditure propensities between education versus non-education functions of state and local governments contributed to different patterns of impact under the two balanced budget incidence simulations (i.e. scenario I: reduced non-education expenditures; scenario II: reduced education expenditures). Reduction in government employment was generally less severe under scenario II, although Construction was harder hit. Other sectors were generally more favorably affected under scenario I, with the exceptions of ANR under both closures, and Timber and Trade under Keynesian closure.

A summary of aggregate impacts for key economic variables is presented in Table 16. The table has been arranged so that impact estimates under each scenario appear roughly in order of increasing time frame based on underlying assumptions. Thus, reading from left to right, Nf denotes the shortest adjustment period under each scenario while Km implies the longest time frame, although not yet long enough to include changes in the regional supply of productive capital (i.e. KTOT is fixed).

From Table 16 we see that in the aggregate, changes in absorption (Q), output (X), regional absorption of regional supply (XXD), exports (E) and imports (M) all increase with increasing time frame, indicating the net direction of direct impact under Measure 5. This is especially apparent under scenario III (i.e. revenue neutral tax incidence), where a longer adjustment period causes net negative impacts on Q, XXD and M to change to positive ones over time.

High income households benefit proportionally more than either low or medium income households under both scenario I and scenario II. This is due to their relatively greater participation in factor markets, and relatively more favorable windfall benefit received via Measure 5 property tax relief. Percentage increases in disposable income for high income households are approximately double those for the low and medium income groups.

Under scenario III (i.e. revenue neutral) analysis, all government expenditures are held harmless. Hence, in absolute terms, reallocation of resources and expenditures between producing sectors is generally less than in the two balanced budget cases. However scenario III also showed the widest divergence between the two basic closures, with neoclassical closure showing some negative results, while Keynesian results were uniformly positive. Low and medium income households were relatively better off under scenario III than under either of the two balanced budget exercises. However this came notably at the expense of high income households, whose consumption and disposable income indicators were significantly negative. Even though total household income increased, higher state income taxes claimed an amount larger

Table 16. SUMMARY OF AGGREGATE IMPACTS UNDER THREE SHOCK SCENARIOS AND FOUR VARIANTS

(PERCENT CHANGE FROM BASELINE)

	BASELINE	Scenario I				Scenario II				Scenario III			
		Nf	Nm	Kf	Km	Nf	Nm	Kf	Km	Nf	Nm	Kf	Km
Q	100656	0.15	0.19	0.62	0.73	0.08	0.11	0.62	0.73	-0.06	-0.03	0.96	1.05
X	94940	0.35	0.38	0.98	1.12	0.27	0.30	1.00	1.13	0.11	0.13	1.31	1.42
XXD	63122	0.04	0.08	0.52	0.63	-0.05	-0.01	0.52	0.62	-0.04	-0.01	0.98	1.07
E	31817	0.97	0.97	1.90	2.08	0.91	0.91	1.97	2.14	0.42	0.41	1.96	2.13
M	35553	0.30	0.32	0.74	0.85	0.25	0.27	0.76	0.87	-0.10	-0.09	0.90	1.00
HHYD(low)	8580	0.84	0.86	1.10	1.18	0.84	0.84	1.14	1.21	0.88	0.86	1.40	1.47
HHYD(med)	20505	0.87	0.88	1.18	1.28	0.88	0.89	1.24	1.33	0.95	0.93	1.59	1.68
HHYD(high)	12252	1.91	1.92	2.26	2.39	1.94	1.95	2.35	2.48	-3.94	-3.94	-2.57	-2.47
LTOT	33595	0	0	0.83	0.96	0	0	0.95	1.07	0	0	1.57	1.68
FTOT	4704	0	0	0	0	0	0	0	0	0	0	0	0
KTOT	8707	0	0	0	0	0	0	0	0	0	0	0	0
GTOT(fed)	1991	0	0	0	0	0	0	0	0	0	0	0	0
GTOT(ned)	6221	-11.1	-11.3	-10.5	-10.6	0	0	0	0	0	0	0	0
GTOT(ed)	3379	0	0	0	0	-20.6	-20.8	-19.3	-19.5	0	0	0	0

Notes: For variable definitions, see appendix A.
Q, X, XXD, E, and M denote aggregates of indexed variables summed across all nine sectors (e.g Q = Q(1)+Q(2)+...+Q(9)).
Scenario I (balanced budget): Fixed state and local education spending.
Scenario II (balanced budget): Fixed state and local non-education spending.
Scenario III (revenue neutral): All government expenditures fixed.
Nf: neoclassical CGE closure; intersectorally fixed capital.
Nm: neoclassical CGE closure; intersectorally mobile capital.
Kf: Keynesian CGE closure; intersectorally fixed capital.
Km: Keynesian CGE closure; intersectorally mobile capital.

than the windfall benefit received by high income households as property tax relief under Ballot Measure 5.

A key feature distinguishing CGE models from conventional (i.e. fixed price) regional models is the inclusion of endogenous, relative prices. In the absence of endogenous prices, response in conventional regional models is limited to quantity adjustment only. In CGE models, response is transmitted as adjustment in both quantity and price components. The difference between the two types of models can be seen in their respective equilibrium conditions. Equation 60 represents the equilibrium condition for fixed-price models while equation 61 is its counterpart for a CGE model.

$$Q_i = XXD_i + M_i ; \forall i \qquad (60)$$

$$Q_i \times P_i = XXD_i \times PD_i + M_i \times pm ; \forall i \qquad (61)$$

Endogenous prices provide another adjustment mechanism, generally moderating the impact on economic quantity variables compared with results of fixed-price models.

Table 17 illustrates the interaction of quantity and price components in the CGE adjustment process. Results of selected variables for three representative sectors are shown along with their respective prices (scenarios and variants are as in Table 16). For example, observe the response of Q(manu) and P(manu) (i.e. the quantity and price of the composite "manufacturing" commodity) across the three scenarios. Under the three scenarios, both variables respond to the economic shock of Measure 5, but the direction of response varies. Under scenario I, variant Nf, Q(manu) increases by 0.14% while its price, P(manu), decreases by 0.01%. For the corresponding variant under scenario II, Q(manu) and P(manu) both decrease by 0.01%. Under scenario III, variant Nf, Q(manu) decreases by 0.27% while P(manu) increases by 0.02%.

Table 17. ILLUSTRATION OF PRICE AND QUANTITY EFFECTS FOR SELECTED SECTORS IN THE OREGON CGE

(PERCENT CHANGE FROM BASELINE)

	Scenario I				Scenario II				Scenario III			
	Nf	Nm	Kf	Km	Nf	Nm	Kf	Km	Nf	Nm	Kf	Km
Q(manu)	0.14	0.03	0.64	0.62	-0.01	-0.14	0.57	0.55	-0.27	-0.38	0.89	0.88
P(manu)	-0.01	0.04	-0.07	-0.02	-0.01	0.05	-0.08	-0.02	0.02	0.07	-0.06	-0.01
Q(timber)	0.53	0.49	1.34	1.68	0.43	0.36	1.37	1.7	-0.05	-0.15	1.62	2.0
P(timber)	-0.12	-0.11	-0.32	-0.43	-0.11	-0.08	-0.33	-0.44	-0.05	-0.01	-0.26	-0.38
Q(servs)	0.55	0.56	1.0	1.07	0.46	0.47	0.99	1.05	-0.56	-0.57	0.47	0.5
P(servs)	0.31	0.32	0.18	0.24	0.31	0.32	0.17	0.23	0.3	0.33	0.14	0.23
XXD(manu)	0.2	-0.16	0.95	0.71	0.03	-0.36	0.91	0.63	-0.34	-0.67	1.14	0.91
PD(manu)	-0.05	0.17	-0.28	-0.07	-0.04	0.2	-0.3	-0.08	0.06	0.27	-0.22	-0.03
XXD(timber)	0.61	0.55	1.54	1.94	0.49	0.41	1.56	1.97	-0.02	-0.14	1.78	2.23
PD(timber)	-0.17	-0.15	-0.45	-0.6	-0.15	-0.12	-0.46	-0.61	-0.07	-0.02	-0.36	-0.53
XXD(servs)	0.51	0.52	0.99	1.05	0.43	0.43	0.97	1.03	-0.59	-0.61	0.45	0.47
PD(servs)	0.39	0.41	0.23	0.3	0.39	0.4	0.21	0.29	0.38	0.41	0.18	0.29
X(manu)	0.24	-0.32	1.22	0.78	0.07	-0.54	1.19	0.71	-0.4	-0.93	1.36	0.95
PX(manu)	-0.02	0.06	-0.1	-0.03	-0.02	0.07	-0.11	-0.03	0.02	0.1	-0.08	-0.01
X(timber)	0.79	0.71	2.01	2.57	0.64	0.53	2.04	2.61	0.05	-0.12	2.15	2.79
PX(timber)	-0.05	-0.05	-0.14	-0.19	-0.05	-0.04	-0.14	-0.19	-0.02	-0.01	-0.11	-0.17
X(servs)	0.49	0.5	0.97	1.03	0.4	0.41	0.96	1.01	-0.61	-0.63	0.44	0.46
PX(servs)	0.33	0.35	0.2	0.25	0.33	0.34	0.18	0.24	0.32	0.35	0.15	0.25

Notes: Q(i), XXD(i) and X(i) are quantity variables for total absorption, regional absorption of regional supply, and total output, respectively. Their respective prices are P(i), PD(i) and PX(i).

Scenario I (balanced budget): Fixed state and local education spending.

Scenario II (balanced budget): Fixed state and local non-education spending.

Scenario III (revenue neutral): All government expenditures fixed.

Nf: neoclassical CGE closure; intersectorally fixed capital.

Nm: neoclassical CGE closure; intersectorally mobile capital.

Kf: Keynesian CGE closure; intersectorally fixed capital.

Km: Keynesian CGE closure; intersectorally mobile capital.

Note that while the direction of total change in Q(manu)xP(manu) is negative for both scenarios II and III, in one case it results from negative quantity and price changes (scenario II), while in the other case (scenario III) it results from the domination of a negative quantity change over a positive price change. Similarly within a given scenario, each price and quantity combination exhibits a range of response as we move from short-term to longer-term adjustment under the four variants. This range of possible response exemplifies the inherent flexibility of CGE models, resulting from an ability to allocate resources among competing uses according to endogenous changes in marginal valuation.

The question remains of which closure method, neoclassical or Keynesian, better approximates the actual regional economic adjustment mechanism. Some regional analysts argue that the supply of capital services is actually more flexible and more important as a determinant of regional adjustment than is labor supply. In recent years, both employment and capital investment in Oregon have been increasing at increasing rates. Hence it seems reasonable to assume that for this economy, at least for small to moderate economic shocks, labor supply would probably not be a binding constraint on economic activity. If this is the case, then the relatively more responsive results demonstrated under Keynesian CGE closure probably come closer to approximating reality than do the more conservative estimates produced under neoclassical closure.

Rattso concluded that any desire to discover general model closure rules was probably in vain, since the specification of underlying behavioral relationships is necessarily determined as much by the context of the problem under investigation as by broader political or economic considerations. This difficulty also seems to support arguments in favor of modeling approaches like the one used here, where results under different polar representations of possible adjustment mechanisms are compared against each other (and/or against any available empirical evidence of regional economic impact).

This analysis doesn't pretend to answer the question of which government programs should be sacrificed. Allocation of government expenditures will continue to be determined in the political arena. Expenditure proportions within government accounts in any model could easily be adjusted so that balanced budget incidence would be invariant no matter which government functions (education, non-education or both) were reduced. It is probably true, however, that the potential for and distribution of economic growth in the region will be significantly affected by the distribution of current government expenditures.

Reducing some taxes may provide economic stimulus and incentive for business expansion or relocation in the short term. It is not granted, however, that increased after-tax incomes will necessarily be spent on regionally produced goods and services. They may go toward fueling increased savings or out-of-state vacations which may contribute little direct economic benefit to the region. This is particularly true in the case of high income households. It is also not clear that any attracted business would necessarily create a large number of permanent, "family wage" jobs. Tax breaks may, rather, attract businesses which offer mostly low wage employment which could just as easily choose to relocate elsewhere in the near future.

Some have suggested that the key to Oregon's future lies in the protection of its natural environment along with provision that reasonable levels of public capital (infrastructure) and human capital (education) are maintained (Whitelaw). There are many examples of resource-based economies set amid regions of great natural beauty. The transition from an extractive, resource-based emphasis to a non-extractive, knowledge-intensive industrial base is by no means automatic. Highly skilled labor is attracted to regions endowed with a mixture of natural, man-made and cultural capital. A pool of highly skilled labor is, in turn, attractive to owners of productive capital. Intelligent collection and allocation of public resources via taxation and government spending is the framework which molds these elements together. In moving from a relatively high tax - high service economy to one with lower taxes but lower levels of public services, Oregon may risk losing some of its attractiveness for owners of labor and capital vis a vis other destinations.

BIBLIOGRAPHY

Advisory Commission on Intergovernmental Relations (ACIR). 1992. *Significant Features of Fiscal Federalism: Vol.2 Revenues and Expenditures.* Washington DC: U.S. Advisory Commission on Intergovernmental Relations.

Alward, G., et al. 1989. Micro IMPLAN Software Manual. Fort Collins, CO: Colorado State University.

Ballard, C. L., D. Fullerton, J. Shoven, and J. Whalley. 1985. *A General Equilibrium Model for Tax Policy Evaluation.* Chicago: The University of Chicago Press.

Boadway, R.W., and D.E. Wildasin. 1984. *Public Sector Economics, 2nd edition.* Boston: Little, Brown and Company.

Boyd, R., and D.H. Newman. 1991. "Tax Reform and Land-Using Sectors: A General Equilibrium Analysis". *American Journal of Agricultural Economics* 73: 398-409.

Brooke, A., D. Kendrick, and A. Meeraus. 1988. *GAMS: A User's Guide.* Redwood City CA: The Scientific Press.

Browning, E.K., and W.R. Johnson. 1979. *The Distribution of the Tax Burden.* Washington, D.C.: American Enterprise Institute.

Dalton, H. 1936. *Principles of Public Finance, 9th edn.* London: Routledge and Kegan.

Decaluw'e, B., and A. Martens. 1989. "CGE modeling of developing economies: a concise empirical survey of 73 applications to 26 countries". *Journal of Policy Modeling* 10(4): 529-68.

Dervis, K., J. de Melo, and S. Robinson. 1982. *General Equilibrium Models for Development Policy.* Cambridge: Cambridge University Press.

Devarajan, S., and J.D. Lewis. 1991. "From Stylized to Applied Models: Building Multisector CGE Models for Policy Analysis". Working Paper No. 616. Berkeley: Department of Ag. and Resource Economics, U. of California at Berkeley.

Dow, S. 1986. "The capital account and regional balance of payments problems". *Urban Studies* 23: 173-84.

Harberger, A.C. 1962. "The Incidence of the Corporation Income Tax". *The Journal of Political Economy* 70: 215-40.

Harrigan, F., and P. McGregor. 1989. "Neoclassical and Keynesian Perspectives on the Regional Macro-Economy: A Computable General Equilibrium Approach". *Journal of Regional Science* 29(4): 555-73.

Hertel, T.W., and M.E. Tsigas. 1988. "Tax Policy and U.S. Agriculture: A General Equilibrium Analysis". *American Journal of Agricultural Economics* 70: 289-302.

Hoffman, R.F. 1972. "Disaggregation and Calculations of the Welfare Cost of a Tax". *Journal of Political Economy* 80: 409-17.

Hong, S. H. 1980. "General Equilibrium Analysis of Korean Taxation Policy." Ph.D. Dissertation. Palo Alto CA: Dept. of Economics, Stanford University.

Johansen, L. 1960. *A Multisector Study of Economic Growth*. Amsterdam: North-Holland.

Jones, R., and J. Whalley. 1991. "Regional Balance Sheets of Gains and Losses from National Policies: Calculations from an Applied General Equilibrium Model for Canada". *Regional Science and Urban Economics* 20: 421-35.

Keller, W.J. 1980. *Tax Incidence: A General Equilibrium Approach*. Amsterdam: North-Holland.

Koh, Y.K. 1991. "Analysis of Oklahoma's Boom and Bust Economy by Means of a CGE Model". Ph.D. Dissertation, Stillwater, OK: Dept. of Ag. Economics, Oklahoma State U.

Koh, Y.K., D.F. Schreiner, and H. Shin. 1992. "Comparisons of Fixed Price Multiplier Analysis with Regional General Equilibrium Analysis for Exogenous changes in the Oklahoma Economy". Paper presented at the Mid-Continent Regional Science Association Meetings, Stillwater, OK: Dept. of Ag. Economics, Oklahoma State U.

Krauss, M.B., and H.G. Johnson. 1972. "The Theory of Tax Incidence: A Diagrammatic Analysis". *Economica* 39: 357-82.

Kraybill, D. 1993. "Computable General Equilibrium Analysis at the Regional Level". In D.M. Otto and T.G. Johnson, eds. *Microcomputer-Based Input-Output Modeling: Applications to Economic Development*. Boulder CO: Westview Press, pp.198-215.

Kraybill, D., and D. Pai. 1993. "2TRADENC.GMS" (GAMS code for a two sector CGE model with endogenous imports and exports). Columbus OH: Dept. of Agricultural Economics and Rural Sociology, Ohio State University.

Lee, H.-S. 1993. "Welfare Measures of Rural Development: A Regional General Equilibrium Analysis Including Non-Market Goods". Unpublished Manuscript. Stillwater OK: Dept. of Agricultural Economics, Oklahoma State University

Marshall, A. 1920. *Principles of Economics, 8th edn*. London: Macmillan.

McGuire, T.J. 1992. "Jobs and Taxes: Do State Taxes Affect Economic Development". Corvallis OR: Program for Governmental Research and Education, Oregon State University.

McLure, C.E., Jr. 1974. "A Diagrammatic Exposition of the Harberger Model with One Immobile Factor". *Journal of Political Economy* 82: 56-82.

McLure, C.E., Jr. 1975. "General Equilibrium Incidence Analysis: The Harberger Model After Ten Years". *Journal of Public Economics* 4: 125-61.

McLure, C.E., Jr., and W.R. Thirsk. 1975. "A Simplified Exposition of the Harberger Model I: Tax Incidence". *National Tax Journal* 28: 1-27.

Mieszkowski, P.M. 1967. "On the Theory of Tax Incidence". *Journal of Political Economy* 75: 250-62.

Mieszkowski, P.M. 1969. "Tax Incidence Theory: The Effects of Taxes on the Distribution of Income". *Journal of Economic Literature* 7: 1103-24.

Morgan, W., J. Mutti, and M. Partridge. 1989. "A Regional General Equilibrium Model of the United States: Tax Effects on Factor Movements and Regional Production". *The Review of Economics and Statistics* 71: 626-35.

Musgrave, R.A. 1953. "The Distributions of Government Burdens and Benefits". *American Economic Review* 43: 504-17.

Mutti, J.H., and W.E. Morgan. 1986. "Interstate Tax Exportation within the United States: An Appraisal of the Literature". *International Regional Science Review* 10(2): 89-112.

Oregon Progress Board. 1989. "Oregon Shines: an Economic Strategy for the Pacific Century - Summary". Salem OR: Oregon Economic Development Department.

Pechman, J.A. 1985. *Who Paid the Taxes, 1966-85?*. Washington D.C.: The Brookings Institution.

Pereira, A.M. 1988. "Survey of Dynamic Computational General Equilibrium Models for Tax Policy Evaluation". *Journal of Policy Modeling* 10(3): 401-36.

Phares, D. 1973. *State-Local Tax Equity: An Empirical Analysis of the Fifty States*. Lexington, MA: Lexington Books.

Phares, D. 1980. *Who Pays State and Local Taxes?*. Cambridge, MA: Oelgeschlager, Gunn and Hain, Publishers, Inc.

Phlips, L. 1983. *Applied Consumption Analysis*. Amsterdam: North Holland.

Piggott, J., and J. Whalley. 1985. *UK Tax Policy and Applied General Equilibrium Analysis*. Cambridge: Cambridge U. Press.

Rattso, J. 1982. "Different Macroclosures of the Original Johansen Model and Their Impact on Policy Evaluation". *Journal of Policy Modeling* 4(1): 85-7.

Rickman, D. 1992. "Estimating the Impacts of Regional Business Assistance Programs: Alternative Closures in a Computable General Equilibrium Model". *Papers in Regional Science* 71(4): 421-35.

Robinson, S., M. Kilkenny, and K. Hanson. 1990. "The USDA/ERS Computable General Equilibrium Model of the U.S.". Staff Report No. AGES 9049. Washington D.C.: ERS, USDA.

Robinson, S., S. Subramanian, and J. Geoghegan. 1993. "A Regional, Environmental, Computable General Equilibrium Model of the Los Angeles Basin". Unpublished Manuscript. Berkeley CA: Department of Ag. and Resource Economics, University of California.

Rose, A., B. Stevens, and G. Davis. 1988. *Natural Resource Policy and Income Distribution*. Baltimore: Johns Hopkins U. Press.

Seligman, E.R.A. 1932. *The Shifting and Incidence of Taxation, 5th edition.* New York: Columbia University Press.

Shoven, J.B., and J. Whalley. 1972. "A General Equilibrium Calculation of the Effects of Differential Taxation of Income from Capital in the U.S.". *Journal of Public Economics* 1: 281-321.

Shoven, J.B., and J. Whalley. 1984. "Applied General-Equilibrium Models of Taxation and International Trade: An Introduction and Survey". *Journal of Economic Literature* 22: 1007-51.

Shoven, J.B., and J. Whalley. 1992. *Applying General Equilibrium.* Cambridge: Cambridge University Press.

State of Oregon, Legislative Revenue Office. 1993. "Basic Tax Packet". Research Report 1-93. Salem OR: Legislative Revenue Office.

State of Oregon, Oregon Department of Revenue. 1993. Tabulated Oregon income tax return data for 1990 tax year. Unpublished facsimile. Salem OR: Oregon Department of Revenue (courtesy of Brian Reeder, December 8, 1993).

U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System. 1993. "Transfer Payments for Counties and Metropolitan Areas". Washington, D.C.: U.S. Government Printing Office.

U.S. Department of Commerce, Bureau of the Census, Economics and Statistics Administration. 1991. "Government Finances: 1989-90". Doc. GF/90-5. Washington D.C.: U.S. Government Printing Office.

U.S. Department of Commerce, Bureau of the Census, Economics and Statistics Administration. 1993. "Government Finances: 1990-91". Doc. GF/91-5. Washington D.C.: U.S. Government Printing Office.

Warner, P., and D. Griffiths. 1990. "The Oregon Revenue Models: Annual Review of Methodology." Mimeo. Salem, OR: State of Oregon, Executive Dept., Office of Economic Analysis (December).

Weber, B., B. Steel, and R. Mason. 1991. "Measure 5: What Did Voters Really Want?". 1991 Legislative Discussion Paper. Corvallis OR: Rural Policy Research Group, Oregon State University.

Wells, P. 1955. "A General Equilibrium Analysis of Excise Taxes". *American Economic Review* 45: 345-59.

Whitelaw, E. 1990. "Oregon's Turn: A Blueprint for Economic Growth in the 1990s". *Old Oregon.* Eugene OR: University of Oregon (Spring:22-4).

APPENDICES

APPENDIX A

LIST OF PARAMETERS, VARIABLES AND EQUATIONS IN THE OREGON CGE MODEL

APPENDIX A. LIST OF PARAMETERS, VARIABLES AND EQUATIONS IN THE OREGON CGE MODEL

PARAMETERS

a(i,j)	import-ridden regional I-O coefficients
exoincome	portion of regional capital income from exogenous sources
sstaxr(gov)	payroll tax rates
depr	capital depreciation rate (a proportion of capital income)
deprec	nominal depreciation (payment to exog. cap. account)
corptaxr(gov)	capital tax rates
retearn	enterprise savings ("retained earnings")
HHSSo(hh)	baseline household property assessments
inctaxr(gov,hh)	average hh income tax rate (% of hh income)
proptaxr(gov)	average res. property tax rate (% of assessed value)
fedflow	fed expends.- fed revenues (receipt from exog. cap. acct.)
nedflow	other s&l govt revenue
fedned	federal govt transfers to s&l govt
feded	direct federal grants for s&l education
neded	transfers from s&l govt to s&l education
cadeficit	current account deficit
exosave	payments to balance savinv acct. (from exog. cap.acct);
TRANSo(gov,hh)	income transfers by govt. to hhs.
WMAT(hh,i)	distribution by industry labor income to households (TABLE)
propyr(hh)	distribution of total proprietors' income to households
entdis(hh)	distribution of total enterprise income to households
BUSSo(i)	benchmark industry property assessment value
bustaxr(gov,i)	industry property tax rates
extaxr(gov,i)	sales and excise tax rate paid by industries
pm	import price
pe	export price
invr(i)	regional investment shares
gdr(i,gov)	regional govt. purchase shares
govsalesr(gov,i)	proportion of non-indus. supply in absorption
ncimpir(i)	non-comparable import share of total output
sigma(i)	elasticity of substitution (Armington function exponent)
delta(i)	armington function share parameter
ac(i)	armington function shift parameter
tau(i)	transformation elasticity (CET function exponent)
gamma(i)	CET function share parameter
at(i)	CET function shift parameter
resadjr	prop. of net lab. earnings paid to non-res. labor
capadjr	propor. of net cap. earnings paid to non-res. owners
retearnr	enterprise savings rate
cshare(i,hh)	LES expenditure shares
ncimpcr(hh)	proportion of non-comparable imps. in hh consump.
sshare(hh)	household savings share of dispos. income
lshare(i)	CD production function labor share exponent
fshare(i)	CD production function proprietors' share exponent
kshare(i)	CD production function capital share exponent
av(i)	CD production function shift coefficient

VARIABLES

LTOT	total regional labor supply
FTOT	total regional supply of proprietors' services
KTOT	total regional supply of capital
L(i)	industry demand for labor
F(i)	industry demand for proprietors' services
K(i)	industry demand for capital
Q(i)	total commod supply (incl govsales)
X(i)	industry output (composite of XXD(i) and E(i))
C(i,hh)	consumption of commodities by households
G(i,gov)	government purchases of commodities
GTOT(gov)	total govt commod purchases
ITOT	total investment
IT(i)	investment expenditure on commodities

ND(i)	intermediate demand for commodities by industries
E(i)	exports of industry output
M(i)	imports of commodities
XXD(i)	regional industry production for regional use
WSTAR	gross unit labor cost
W	net wage
PP	unit return to proprietors
RSTAR	gross unit cost of capital
R	net capital rental rate
STAX(gov)	payroll tax receipts
RADJ(i)	net residence adjustment
CTAX(gov)	capital tax receipts
CADJ	net capital adjustment
BUTAX(gov,i)	industry property taxes
EXCTAX(gov,i)	industry sales and excise taxes
ITAX(gov,i)	indirect business tax receipts
INDIMP(i)	non-comparable imports by industry
GS(gov,i)	non-industrial commod. supply
FEDINC(hh)	adjusted fed taxable income
NEDINC(hh)	adjusted ned taxable income
PROTAX(gov,hh)	property tax receipts from households
INTAXR(hh)	ned income tax rates
INCTAXX(gov,hh)	income tax receipts from households
HTAX(gov,hh)	total tax receipts from households
HHIMP(hh)	non-comparable imports by households
P(i)	price of composite commodity (price of Q(i))
PV(i)	value-added prices (net of IBT and intermed. demand)
PD(i)	price of regionally-produced goods (price of XXD(i))
PX(i)	average price of industry output (price of X(i))
LABY(i)	net regional labor earnings
PROPY	net regional proprietors' earnings
CAPY	net regional capital income
ENTY	net regional enterprise income
HHY(hh)	regional household income
HHYD(hh)	regional disposable income
HHSAV(hh)	net household savings
EXOSAV	exogenous "foreign" savings
FEDFLO	federal government budget deficit
EDTRANS	transfers from s&l general fund to education
NEDFLO	other s&l revenues (misc. taxes and interest)
CADEF	current account deficit
ER	"exchange rate" variable to balance current account
OMEGA	objective function variable;

LIST OF EQUATIONS

PRODFCN(I)	C-D production functions determining industry output
FOCLAB(I)	f.o.c. determining labor wage rate
FOCPROP(I)	f.o.c. determining rate of return for proprietors' services
FOCCAP(I)	f.o.c. determining capital rental rate
NETWAGE	definition of net wage
NETRENT	definition of net capital rental rate
PVALADD(I)	definition of regional value-added prices
SOCTAX(gov)	payroll tax receipts
CAPTAX(gov)	capital tax receipts
RESLAB(i)	definition of residence adjustment
RESCAP	definition of capital adjustment
BUSINESS(gov,i)	industry property taxes
EXCISE(gov,i)	industry sales and excise taxes
INDTAX(gov,i)	industry indirect taxes
IIMP(i)	non-comparble imports by industry
PROPERTYT(gov,hh)	household property tax collections
FINC(hh)	adjusted income for computing fed income tax
NINCL	adjusted income for computing lowhhs ned income tax
NINCM	adjusted income for computing medhhs ned income tax
NINCH	adjusted income for computing hihhs ned income tax
FINCOMET(hh)	fed income tax payments
NINCOMET(hh)	ned income tax payments
HOUSETAX(gov,hh)	total household tax collections

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HIMP(hh)            non-comparable imports by households
GOVSUP(gov,i)       total non-industrial commodity supply
ARMINGTON(I)    definition of composite absorption commodity
BUDGET(I)       budget constraint on commodity absorption
IMPORT(I)       ratio of commodity imports to domestic commodity supply
CET(I)          transformation of industry output
REVENUE(I)      industry revenue function
EXPORT(I)       ratio of industry exports to domestic commodity demand
INTDEM(I)       definition of intermediate demand
CONSUM(I,HH)    definition of household consumption
GDSMKTEQ(I)     goods market equilibrium condition
LABINCOM(i)     definition of regional labor income by P.O.R.
PROPINCOM       def. of reg. proprietors' income by P.O.R.
CAPINCOM        def. of regional capital income by P.O.R.
ENTINCOM        def. of regional enterprise income
INCOME(hh)      definition of regional hh income
DISINCOME(hh)   regional hh disposable income
CURRACCT        definition of foreign savings
TOTGOV(i,gov)    definition of total govt commod purchases
FEDDEF          definition of regional federal govt "deficit"
NEDDEF          s&l govt "other revenue"
EDDEF           general fund flows to education
TOTINV(i)          definition of total physical investment
SAVINVEQ        saving-investment equilibrium condition
*FINANCE          external capital account equilibrium condition
LABMKTEQ        labor market equilibrium condition
PROPMKTEQ       equilibrium condition in market for proprietors' services
CAPMKTEQ        capital market equilibrium condition
OBJ             objective function;
```

MODEL EQUATIONS

```
PRODFCN(i)..    X(i) =E= av(i)*L(i)**lshare(i)*F(i)**fshare(i)*K(i)**kshare(i);
FOCLAB(i)..     WSTAR  =E= PV(i) * lshare(i)*X(i)/L(i);
FOCPROP(i)..    PP*F(i) =E= PV(i) * fshare(i)*X(i);
FOCCAP(i)..     RSTAR  =E= PV(i) * kshare(i)*X(i)/K(i);
NETWAGE..       W =E= WSTAR * (1 - sum(gov, sstaxr(gov)));
NETRENT..       R =E= RSTAR * (1 - sum(gov, corptaxr(gov)) - depr);
PVALADD(i)..    PV(i) =E= PX(i)*(1 - sum(gov, ITAX(gov,i) / (PX(i)*X(i)))
                        - ncimpir(i)) - sum(j, a(j,i)*P(j));
SOCTAX(gov)..   STAX(gov) =E= sstaxr(gov) * sum(i, L(i))*WSTAR;
CAPTAX(gov)..   CTAX(gov) =E= corptaxr(gov) * sum(i, K(i))*RSTAR;
RESLAB(i)..     RADJ(i) =E= resadjr * L(i)*W;
RESCAP..        CADJ =E= capadjr * sum(i, K(i))*R;
BUSINESS(gov,i)..   BUTAX(gov,i)  =E= bustaxr(gov,i) * BUSSo(i);
EXCISE(gov,i)..     EXCTAX(gov,i) =E= extaxr(gov,i) * X(i);
INDTAX(gov,i)..     ITAX(gov,i) =E= BUTAX(gov,i) + EXCTAX(gov,i);
IIMP(i)..           INDIMP(i) =E= ncimpir(i) * X(i) * PX(i) / pm*ER;
PROPERTYT(gov,hh).. PROTAX(gov,hh) =E= proptaxr(gov) * HHSSo(hh);
FINC(hh)..          FEDINC(hh) =E= HHY(hh) - sum(gov, PROTAX(gov,hh));
NINCL..             NEDINC("low") =E= HHY("low") - INCTAXX("fed","low");
NINCM..             NEDINC("med") =E= HHY("med") - INCTAXX("fed","med");
NINCH..             NEDINC("hi") =E= HHY("hi");
FINCOMET(hh)..      INCTAXX("fed",hh) =E= inctaxr("fed",hh) * FEDINC(hh);
NINCOMET(hh)..      INCTAXX("ned",hh) =E= INTAXR(hh) * NEDINC(hh);
HOUSETAX(gov,hh)..  HTAX(gov,hh) =E= PROTAX(gov,hh) + INCTAXX(gov,hh);
HIMP(hh)..          HHIMP(hh) =E= ncimpcr(hh) * HHYD(hh) / pm*ER;
GOVSUP(gov,i)..     GS(gov,I) =E= Q(i) * govsalesr(gov,i);
ARMINGTON(i)..     Q(i) =E= ac(i) * (delta(i)*M(i)**((sigma(i)-1)/sigma(i))
      +(1-delta(i))*XXD(i)**((sigma(i)-1)/sigma(i)))**(sigma(i)/(sigma(i)-1))
      +sum(gov, GS(gov,i));
BUDGET(i)..    P(i)*Q(i) =E= PD(i)*(XXD(i) + sum(gov,GS(gov,i))) + pm*ER*M(i);
IMPORT(i)..    M(i) =E= XXD(i)*(PD(i)/(pm*ER)*delta(i)/(1-delta(i)))**sigma(i);
CET(i)..                X(i) =E= at(i)*(gamma(i)*E(i)**((tau(i)+1)/tau(i))
+(1-gamma(i))*XXD(i)**((tau(i)+1)/tau(i)))**(tau(i)/(tau(i)+1));
REVENUE(i)..   PX(i)*X(i) =E= PD(i)*XXD(i) + pe*ER* E(i);
EXPORT(i)..    E(i) =E= XXD(i)*(pe*ER/PD(i) * (1-gamma(i))/gamma(i))**tau(i);
INTDEM(i)..    ND(i) =E= SUM(J, a(i,j)*X(j));
CONSUM(i,hh)..  C(i,hh) =E= cshare(i,hh)/P(i) * HHYD(hh);
```

```
GDSMKTEQ(i)..   Q(i) =E= ND(i) + sum(hh, C(i,hh)) + IT(i) + sum(gov, G(i,gov));
LABINCOM(i)..   LABY(i) =E= L(i)*W - RADJ(i);
PROPINCOM..     PROPY =E= sum(i, F(i) * PP);
CAPINCOM..      CAPY =E= sum(i, K(i))*R - CADJ;
ENTINCOM..      ENTY =E= (1 - retearnr) * (CAPY + exoincome);
INCOME(hh)..     HHY(hh) =E= sum(i, WMAT(HH,I)*LABY(i)) + HHFY(hh,"propr")*PROPY
                         + entdis(hh)*ENTY + sum(gov, TRANSo(gov,hh);
DISINCOME(hh)..  HHYD(hh) =E= HHY(hh) - sum(gov, HTAX(gov,hh));
CURRACCT..       CADEF =E= sum(i, RADJ(i)) + CADJ + SUM(i, M(i))*pm*ER
                        + sum(i, INDIMP(i))*pm*ER
                        + sum(hh, HHIMP(hh))*pm*ER - SUM(i, E(i))*pe*ER;
TOTGOV(i,gov)..  G(i,gov) =E= gdr(i,gov) * GTOT(gov);
FEDDEF..         FEDFLO =E= sum(i, G(i,"fed")*P(i)) + sum(hh, TRANSo("fed",hh))
                        + fedned + feded - STAX("fed") - CTAX("fed")
                        - sum(i, GS("fed",i)*PD(i)) - sum(i, ITAX("fed",i))
                        - sum(hh, HTAX("fed",hh));
NEDDEF..         NEDFLO =E= sum(i, G(i,"ned")*P(i)) + sum(hh, TRANSo("ned",hh))
                        + EDTRANS - STAX("ned") - CTAX("ned")
                        - sum(i, GS("ned",i)*PD(i)) - sum(i, ITAX("ned",i))
                        - sum(hh, HTAX("ned",hh)) - fedned;
EDDEF..          EDTRANS =E= sum(i, G(i,"ed")*P(i)) - sum(i, ITAX("ed",i))
                        - sum(hh, HTAX("ed",hh)) - feded;
TOTINV(i)..   IT(i) =E= invr(i)/P(i) *ITOT ;
SAVINVEQ..    EXOSAV =E= sum(i, IT(i)*P(i)) - sum(hh, sshare(hh)*HHYD(hh));
*FINANCE..    exoincome =E= depr*sum(i, K(i))*RSTAR + retearnr*(CAPY+exoincome)
*                 + CADEF - sum(hh, PRIVTRANSo(hh)) - FEDFLO - NEDFLO - EXOSAV;
LABMKTEQ..     LTOT =E= SUM(i,L(I));
PROPMKTEQ..    FTOT =E= SUM(i,F(I));
CAPMKTEQ..     KTOT =E= SUM(i,K(I));
OBJ..         OMEGA =E= SUM((i,hh), C(i,hh));
```

NEOCLASSICAL MODEL CLOSURE

```
LTOT.FX = LTOT.L;
FTOT.FX = FTOT.L;
KTOT.FX = KTOT.L;
*ITOT.FX = ITOT.L;
EXOSAV.FX = EXOSAV.L;
NEDFLO.FX        = NEDFLO.L;
INCTAXX.FX("ed",hh) = 0;
ER.FX = 1.0;
```

KEYNESIAN MODEL CLOSURE

```
*LTOT.FX = LTOT.L;
WSTAR.FX = WSTAR.L;
FTOT.FX = FTOT.L;
KTOT.FX = KTOT.L;
ITOT.FX = ITOT.L;
*EXOSAV.FX = EXOSAV.L;
NEDFLO.FX        = NEDFLO.L;
INCTAXX.FX("ed",hh) = 0;
ER.FX = 1.0;
```

APPENDIX B

GAMS CODING USED FOR DIFFERENTIAL INCIDENCE ANALYSIS

APPENDIX B. GAMS CODING USED FOR DIFFERENTIAL INCIDENCE ANALYSIS

```
* 903.GMS  "NEOCLASSICAL" SAVINV and Labor Mkt. Closure    June 15, 1994
***Exogenous S/L Non-ed. Govt. Commodity Purchases
***Endogenous non-ed. income tax rate on "hi" income households
*Import Ridden NINE-SECTOR OR CGE using IMPLAN DATA w/ ENDOG. IMPORT EQS
*PROGRAMMED BY E.C. Waters (adapted from D. KRAYBILL AND DEE-YU PAI)
$TITLE  NINE SECTOR Oregon CGE using IMPLAN DATA WITH ENDOG. IMPORT EQS
$OFFUPPER OFFDOLLAR
$OFFSYMLIST OFFSYMXREF OFFUELLIST OFFUELXREF

*############### SETS FOR READING INDUSTRY (IMPLAN) DATA ################
SETS
 I     producing sectors   /  ANR      incl. Food Proc.
                              CONSTR   Construction
                              MANU     Manufacturing (excl. food & wood)
                              TIMBER   Logging+Wood & Paper Prods.
                              TCU      Trans.+Comm.+Utilities
                              TRADE    Trade and Hospitality
                              FIRE     Finance+Insur.+Real Estate
                              SERVS    Other Services
                              GOVT     Gov. Enter.+Gov. Indus.+HH Indus. /

 IG(I)   GOODS  / ANR, CONSTR, MANU, TIMBER /
 IS(I)   SERVICES  / TCU, TRADE, FIRE, SERVS, GOVT /

 ZC    consuming sectors    /LOW         pers. consumption by low-income hh
                             MED         pers. consumption by medium-income hh
                             HIGH        pers. consumption by high-income hh
                             FEDNM       federal non-military purchases
                             FEDMIL      federal military purchases
                             SLNE        state-local govt non-ed. purchases
                             SLED        state-local govt edu. purchases
                             SLPURCH     combined s&l govt purchases /

 ZI  invest & trade sec.  /INVENT       inventory additions
                           CAPFORM      capital formation
                           ADJCAP       capform plus positive invent change
                           ADJDOMEX     domex plus negative invent change
                           DOMEXP       domestic exports
                           FOREXP       foreign exports
                           INDOUT       industry output /

 ZF  factors of production   /EMPCOMP      employee compensation
                              IBT          indirect business taxes
                              PROPINC      proprietary income
                              OPINC        other property income
                              EMPL         employment /

 ZT  trade & non-indus. supply  /CIMP       commodity imports
                                 SLSALES    sales by s&l govt indus.
                                 FEDSALES   sales by fed govt indus.
                                 INDIMP     imports by regional industries
                                 TIO        total industrial outlays /
ALIAS(I,J);
ALIAS(IG,JG);
ALIAS(IS,JS);


* ###################### MODIFIED IMPLAN DATA ########################
TABLE    T402(I,J)    IMPORT RIDDEN TRANSAC. MATRIX (DAVE.EXE)
            ANR     CONSTR    MANU    TIMBER     TCU     TRADE     FIRE    SERVS     GOVT
ANR       3521.95   145.75   633.05   629.97    542.36   967.48   176.25   206.13     6.38
CONSTR      89.36     9.70   110.96    86.74    335.18    47.28   454.50   223.92   185.64
MANU      1421.04  1852.78  5501.07  1263.32    552.49   272.56   148.63  1785.28    79.84
TIMBER     252.12   417.11   380.03  2347.53      8.64    60.20    10.12    90.75     0.63
TCU        633.92   333.25  1147.91  1059.01   1012.63   428.26   224.49   692.83   190.88
```

TRADE	362.69	564.93	626.60	391.45	102.73	119.32	62.76	366.49	13.13
FIRE	353.90	101.52	196.66	124.16	216.20	317.64	1869.66	1028.47	27.19
SERVS	410.80	939.98	696.71	364.24	518.63	677.92	694.87	2059.45	37.76
GOVT	73.51	22.36	128.41	117.96	93.23	93.19	137.63	228.07	23.12

TABLE T403A(I,ZC) IMPORT RIDDEN REG. CONSUMP. DEMAND (DAVE.EXE)

	LOW	MED	HIGH	FEDNM	FEDMIL	SLNE	SLED	SLPURCH
ANR	800.43	1521.82	747.93	36.10	55.38	144.35	13.01	157.36
CONSTR	0.00	0.00	0.00	39.45	213.64	1156.91	1057.69	716.60
MANU	1174.87	3308.98	1818.38	8.42	251.94	893.38	495.10	577.48
TIMBER	88.69	184.03	79.73	1.00	4.27	47.0	5.38	52.38
TCU	607.69	1368.07	766.88	2.54	273.65	305.41	175.33	348.74
Trade	1618.28	3932.04	2384.03	3.15	8.63	208.36	96.78	135.14
FIRE	1444.61	3897.35	800.57	1.86	0.11	33.78	45.55	79.33
Servs	2384.26	4865.94	3197.70	34.05	13.84	234.67	133.88	347.55
GOVT	298.41	753.64	349.66	840.24	202.91	3197.4	1356.10	4553.50

TABLE T403B(I,ZI) IMPORT RIDDEN REG. INVEST. AND TRADE DEMAND (DAVE.EXE)

	INVENT	CAPFORM	ADJCAP	ADJDOMEX	DOMEXP	FOREXP	INDOUT
ANR	107.95	25.74	199.22	5221.74	5239.12	620.39	9978.28
CONSTR	0.00	4521.31	3158.34	206.45	206.45	1.89	7298.86
MANU	69.54	2145.64	1564.19	7418.26	7418.26	2260.57	15292.56
TIMBER	186.18	176.87	363.05	5847.79	5847.79	941.17	9890.19
TCU	-9.69	82.57	206.34	1774.56	1784.28	386.14	8447.41
Trade	8.55	369.75	208.30	1681.45	1681.45	569.01	11804.70
FIRE	0.00	96.17	96.17	1683.01	1683.01	230.46	12217.84
Servs	-1.39	44.16	167.95	2234.95	2236.34	137.90	15856.76
GOVT	-193.30	3.91	3.94	311.36	504.69	289.97	7443.44

TABLE T404A(I,ZF) FINAL PAYMENTS (FACTORS)

	EMPCOMP	IBT	PROPINC	OPINC	EMPL
ANR	1172.51	328.97	1032.13	317.73	
CONSTR	2193.99	31.10	511.90	147.18	
MANU	4226.05	178.52	125.47	1316.15	
TIMBER	2461.05	147.75	157.61	735.23	
TCU	2306.50	374.59	338.30	2041.31	
TRADE	6500.10	1051.66	390.63	878.21	
FIRE	1851.38	1785.95	65.37	2291.45	
Servs	6354.22	104.97	2082.97	630.95	
GOVT	6529.60	0.62	0.00	348.81	

TABLE T404B(I,ZT) FINAL PAYMENTS (IMPORTS AND NON-INDUS. SUPPLY)

	CIMP	SLSALES	FEDSALES	INDIMP	TIO
ANR	5326.37	245.73	639.31	3206.18	9978.28
CONSTR	78.82	0.00	0.00	1874.95	7298.83
MANU	16724.35	40.27	13.88	5333.61	15292.60
Timber	1239.04	0.00	0.01	1887.01	9890.19
TCU	3003.27	139.08	0.00	1557.30	8447.44
Trade	1048.18	467.26	0.00	1180.70	11804.69
FIRE	3541.09	0.08	0.33	1192.75	8927.37
Servs	3541.36	407.38	0.00	2696.74	15856.76
GOVT	1050.05	0.21	27.09	0.00	7443.76

```
PARAMETER  nci(i)   noncomparable imports to interindustry demand
             / ANR        7.65
               CONSTR    27.28
               MANU      25.01
               TIMBER     4.17
               TCU        4.65
               Trade      0.19
               FIRE       1.02
               Servs      2.26
               GOVT       0.16  /;
```

```
PARAMETER  nch(zc)  noncomparable imports to household and govt demand
        /  LOW        66.72
           MED       181.94
           HIGH       86.41
           FEDNM       0
           FEDMIL      0
           SLNE        0
           SLED        0
           SLPURCH     0   /;

*############# SETS FOR READING SOCIAL ACCOUNTING DATA #############
SETS

 FAC   factor accounts           / lab        labor
                                   propr      proprietors
                                   cap        capital /

 HH   household income classes  / low   1990 hh income  under 20 thousand
                                  med   1990 hh income 20-40 thousand
                                  hi    1990 hh income greater 40 thousand /

 GOV  government accounts       / fed   federal govt
                                  ned   s&l non-educational
                                  ed    s&l education /

 TRANS  govt transfer payments /  soc    retirement & disab. insurance bens.
                                  med    medical benefits
                                  inc    income maintenance benefits
                                  unemp  unemployment insurance bens.
                                  vet    veterans benefits
                                  oth    other benefits     /

* # # # # # # # # # # # # # # # # # # # # # # # # #    H O U S E H O L D    T A X E S
##################################

TABLE  INTAX(GOV,HH)  DISTRIB. OF HH INCOME TAX PAYMENTS (OR Revenue Dept.)
             LOW       MED      HI
   FED      288.10    883.28  2702.66
   NED      190.85    485.83  1154.79
   ED         0          0       0

TABLE  PTAX(GOV,HH)  DISTRIB. OF HH PROPERTY TAX PAYMENTS (OR Revenue Dept.)
             LOW       MED      HI
   FED        0         0        0
   NED      48.33     104.72    249.71
   ED       95.94     207.87    495.69

PARAMETER
  totassess          TOTAL 1990 ASSESSED VALUE OF OREGON PROPERTY
  land               ASSESSED VALUE OF RESIDENTIAL LAND
  improve            ASSESSED VALUE OF RESIDENTIAL PROPERTY IMPROVEMENTS
  resassess          TOTAL ASSESSED VALUE OF RESIDENTIAL LAND AND PROPERTY
  prx                TOTAL HH PROPERTY TAX PAYMENTS
  ashare(hh)         SHARE OF TOTAL ASSESSMENT BY INCOME CLASS
  hhassess(hh)       PROPERTY ASSESSMENT value BY HH INCOME CLASS
  inctax(gov,hh)     HOUSEHOLD INCOME TAX PAYMENTS
  proptax(gov,hh)    HOUSEHOLD PROPERTY TAX PAYMENTS
  salestax(gov,hh)   HOUSEHOLD SALES TAX PAYMENTS
  hhtax(gov,hh)      COMBINED DIRECT HOUSEHOLD TAX PAYMENTS
  busassess          ASSESSED VALUE OF NON-RESIDENTIAL PROPERTY;

  totassess = 94320;
  land = 12480 + 1532;
  improve = 27464;
  resassess = land + improve;
  prx = sum((gov,hh), PTAX(GOV,HH));
  ashare(hh) = (sum(gov, PTAX(GOV,HH))) / prx;
  hhassess(hh) = ashare(hh) * resassess;
```

```
inctax(gov,hh) = INTAX(gov,hh);
proptax(gov,hh) = PTAX(gov,hh);
salestax(gov,hh) = 0;
hhtax(gov,hh) = inctax(gov,hh) + proptax(gov,hh) + salestax(gov,hh);
busassess = totassess - resassess;

* # # # # # # # # # # # # # # # # # # # # # # # # #     I N D U S T R Y     T A X E S
####################################

TABLE  BTAX(GOV,I)  DISTRIBUTION OF BUSINESS PROPERTY TAX PAYMENTS
        ANR    CONSTR  MANU   TIMBER   TCU     TRADE    FIRE     SERVS   GOVT
 FED    0      0       0      0        0       0        0        0       0
 NED    47.28  4.3     25.79  21.49    55.88   150.43   107.45   17.19   0
 ED     95.99  8.72    52.36  43.63    113.44  298.95   218.16   34.91   0

TABLE  ETAX(GOV,I)  DISTRIBUTION OF SALES AND EXCISE TAX PAYMENTS
        ANR     CONSTR  MANU   TIMBER   TCU     TRADE    FIRE     SERVS   GOVT
 FED    61.55   5.82    33.41  27.64    70.11   196.72   334.15   19.64   .12
 NED    124.15  12.26   66.96  54.99    135.16  405.61   279.48   33.23   .50
 ED     0       0       0      0        0       0        0        0       0

PARAMETER
  bustax(gov,i)       PROPERTY TAXES PAID BY INDUSTRIES
  bux                 TOTAL industry PROPERTY TAX PAYMENTS
  bshare(i)           SHARE OF business ASSESSMENT BY industry
  indassess(i)        PROPERTY ASSESSMENT value BY industry
  extax(gov,i)        SALES AND EXCISE TAXES PAID BY INDUSTRIES
  ibtax(gov,i)        INDUSTRY INDIRECT BUSINESS TAX PAYMENTS;

  bustax(gov,i) = BTAX(GOV,I);
  bux = sum((gov,i), BTAX(GOV,I));
  bshare(i) = (sum(gov, BTAX(GOV,i))) / bux;
  indassess(i) = bshare(i) * busassess;
  extax(gov,i) = ETAX(GOV,I);
  ibtax(gov,i) = bustax(gov,i) + extax(gov,i);

PARAMETER  corptax(gov)  TOTAL CORP. INCOME TAX COLLECTIONS (fed = 3.32*ned)
                       / fed    484.72
                         ned    145.883
                         ed       0      / ;

PARAMETER  sstax(gov)   TOTAL PAYROLL TAX COLLECTIONS (fed = 13.88 * ned)
                      / fed    4827.66
                        ned    347.79
                        ed       0      / ;

* # # # # # # # # # # # # # # # # # # # # # #     I N C O M E     D I S T R I B U T I O N
##############################
TABLE    HHFY(HH,FAC)  HOUSEHOLD DISTRIBUTION OF REG. FAC. INCOME (IMPLAN SAM)
          LAB       PROPR    CAP
  LOW     .072159   .01      0
  MED     .615153   .44      0
  HI      .312688   .55      0

PARAMETER  entdis(hh)  HOUSEHOLD DISTRIBUTION OF ENTERPRISE INCOME (IMP SAM)
                     / low     .1413
                       med     .50
                       hi      .3587 /;

TABLE    WMAT(HH,I)  HH DISTRIB. OF Wage & Salary INCOME (Rose et al.)
        ANR   Constr  Manu  Timber  TCU    Trade  FIRE   Servs  Govt
 low    .2489 .2050   .16   .2055   .1820  .18    .1419  .17    .13
 med    .4406 .4699   .47   .4763   .4623  .48    .3810  .41    .44
 hi     .3105 .3251   .37   .3182   .3557  .34    .4771  .42    .43

TABLE    TRANSF(GOV,TRANS)  TRANSFER PAYMENTS BY GOVT SOURCE (BEA)
          SOC       MED       INC      UNEMP     VET      OTH
 FED      3927.81   1378.26   362.68   0         234.16   106.11
```

```
  NED     551.04      392.0     156.73    280.08        0         0
  ED        0           0         0         0           0         0

TABLE  TRANSHARE(GOV,HH)  household shares of govt transfers (IMPLAN SAM)
        low    med     hi
  FED    .44    .47    .09
  NED    .44    .47    .09
  ED      0      0      0

PARAMETER
  transpay(gov)         TOTAL GOVERNMENT TRANSFER PAYMENTS
  transfers(gov,hh)     RECEIPT OF TRANSFERS BY HOUSEHOLD CLASS;
  transpay(gov) = sum(trans, TRANSF(GOV,TRANS));
  transfers("fed",hh) =  TRANSHARE("FED",hh) * transpay("fed");
  transfers("ned",hh) =  TRANSHARE("NED",hh) * transpay("ned");

PARAMETER  privtrans(hh)  other income transfers
         / low     0
           med     0
           hi      0 /;

* ##################### SOCIAL ACCOUNTING MATRIX ###################
PARAMETER
 intermed(i,j)       interindustry transactions
 labincome(i)        employee compensation paid by industry i
 propincome(i)       proprietors' income paid by indus. i
 capincome(i)        other property income paid by indus. i
 valadd(i)           regional value added
 imports(i)          commodity imports
 ncimpc(hh)          non-comparable imports by households
 ncimpi(i)           non-comparable imports by industries
*ncimpt              non-comparable imported investment goods
 output(i)           total industry output
 consume(i,hh)       household consumption
 eta                 prop. of reg. cap. income paid to reg. enterprise (assump.)
 exoincome           portion of regional capital income from exogenous sources
 facincome(fac)      income received by regional factor accounts
 entincome           income received by regional enterprise account
 sstaxr(gov)         payroll tax rates
 rjr(i)              proportion of total net res adj. paid by each industry
 resadj(i)           net residence adjustment paid by industries (BEA)
 depr                capital depreciation rate (a proportion of capital income)
 deprec              nominal depreciation (payment to exog. cap. account)
 corptaxr(gov)       capital tax rates
 capadj              payments to non-res. cap. owners (payment to curr. acct.)
 retearn             enterprise savings ("retained earnings")
 hhincome(hh)        household income
 inctaxr(gov,hh)     average hh income tax rate (% of hh income)
 proptaxr(gov)       average res. property tax rate (% of assessed value)
 dincome(hh)         disposable household income
 savings(hh)         household savings
 govdemand(i,gov)    government purchases
 govsales(gov,i)     commodity sales by government sectors (non-indus. supply)
 fedflow             fed expends.- fed revenues (receipt from exog. cap. acct.)
 nedflow             other s&l govt revenue
 fedned              federal govt transfers to s&l govt
 feded               direct federal grants for s&l education
 neded               transfers from s&l govt to s&l education
 invdemand(i)        private investment demand
 exports(i)          industry exports
 cadeficit           current account deficit
 make(i)             regional production for regional use
 absorb(i)           regional absorption
 exosave             payments to balance savinv acct. (from exog. cap.acct);

* //////////////// ASSIGN ECONOMIC LABELS TO FLOWS ///////////////////

intermed(i,j) = T402(I,J);
```

```
labincome(i) = T404A(I,"EMPCOMP");
propincome(i) = T404A(i,"PROPINC");
capincome(i) = T404A(i,"OPINC");
valadd(i) = labincome(i)+propincome(i)+capincome(i)+sum(gov,ibtax(gov,i));
imports(i) = T404B(I,"cimp");
ncimpc("low") = NCH("low");
ncimpc("med") = NCH("med");
ncimpc("hi") = NCH("high");
ncimpi(i) = NCI(i);
*ncimpt    = NCT("adjcap");
output(i) = T404B(i,"TIO");
consume(i,"low") = T403A(i,"LOW");
consume(i,"med") = T403A(i,"MED");
consume(i,"hi")  = T403A(i,"HIGH");
eta = .25;
facincome("lab") = sum(i,labincome(i));
facincome("propr") = sum(i,propincome(i));
facincome("cap") = sum(i,capincome(i));
entincome = 8930;
sstaxr(gov) = sstax(gov)/facincome("lab");
rjr(i)  = labincome(i)/facincome("lab");
resadj(i)  =  rjr(i)*485.375;
depr  =  .4281;
deprec = depr * facincome("cap");
corptaxr(gov) = corptax(gov)/facincome("cap");
capadj = (1-eta-depr) * facincome("cap") - sum(gov, corptax(gov));
retearn = 714.4;
exoincome = entincome - eta*facincome("cap");
hhincome(hh) = sum(i, WMAT(HH,I)*(labincome(i)*(1- sum(gov, sstaxr(gov)))
               - resadj(i)))
               + HHFY(HH,"PROPR")*facincome("propr")
               + entdis(hh)*(entincome - retearn)
               + sum(gov, transfers(gov,hh)) + privtrans(hh);
inctaxr("fed",hh) = inctax("fed",hh) /
                    (hhincome(hh) - sum(gov, proptax(gov,hh)));
inctaxr("ned",hh) = inctax("ned",hh) / (hhincome(hh) - inctax("fed",hh));
inctaxr("ned","hi") = inctax("ned","hi") / hhincome("hi");
inctaxr("ed",hh) = 0;
proptaxr(gov) = sum(hh, proptax(gov,hh)) / resassess;
dincome(hh) = hhincome(hh) - sum(gov, hhtax(gov,hh));
savings(hh) = dincome(hh) - sum(i, consume(i,hh)) - ncimpc(hh);
govdemand(i,"fed") = T403A(i,"FEDNM") + T403A(i,"FEDMIL");
govdemand(i,"ned") = T403A(i,"SLNE");
govdemand(i,"ed")  = T403A(i,"SLED");
govsales("fed",i)  = T404B(I,"FEDSALES");
govsales("ned",i)  = T404B(I,"SLSALES");
fedned = 1640;
feded =  360;
fedflow = sum(i, govdemand(i,"fed")) + sum(hh, transfers("fed",hh))
          + fedned + feded - sstax("fed") - corptax("fed")
          - sum(i, govsales("fed",i)) - sum(i, ibtax("fed",i))
          - sum(hh, hhtax("fed",hh));

neded = sum(i, govdemand(i,"ed")) - sum(i, ibtax("ed",i))
          - sum(hh, hhtax("ed",hh)) - feded;

nedflow = sum(i, govdemand(i,"ned")) + sum(hh, transfers("ned",hh))
         + neded - sstax("ned") - corptax("ned") - sum(i, govsales("ned",i))
         - sum(i, ibtax("ned",i)) - sum(hh, hhtax("ned",hh)) - fedned;

invdemand(i) = T403B(I,"ADJCAP");
exports(i) = T403B(I,"ADJDOMEX") + T403B(I,"FOREXP");
cadeficit = sum(i, resadj(i)) + capadj + SUM(I, IMPORTS(I))
         + sum(i, ncimpi(i)) + sum(hh, ncimpc(hh)) - SUM(I, EXPORTS(I));

make(i) =  output(i) - exports(i);
absorb(i) = make(i) + sum(gov, govsales(gov,i)) + imports(i);
exosave = sum(i, invdemand(i)) - sum(hh, savings(hh));
```

```
* ////////////////////////// SAM EQUATIONS ///////////////////////
*## for SAM
  SET ISAM  categories
          /LABOR,PROP,CAPITAL,COM1,COM433,IND1,IND433,ENTER,
           HHLOW,HHMED,HHHI,FED,NONED,EDU,SAVINV,CURRACC,FINANCE,TOTAL/

     ISAM1(isam)   /TOTAL/
     ISAM2(isam) ;
  ALIAS(isam2,isam3);
PARAMETER SAM(isam,isam) SOCIAL ACCOUNTING MATRIX ;
  isam2(isam) = NOT isam1(isam) ;

 SAM("LABOR","IND1") = sum(ig, labincome(ig));
 SAM("LABOR","IND433") = sum(is, labincome(is));

 SAM("PROP","IND1") = sum(ig, propincome(ig));
 SAM("PROP","IND433") = sum(is, propincome(is));

 SAM("CAPITAL","IND1") = sum(ig, capincome(ig));
 SAM("CAPITAL","IND433") = sum(is, capincome(is));

 SAM("com1","IND1") = sum((ig,jg), intermed(ig,jg));
 SAM("com1","IND433") = sum((ig,is), intermed(ig,is));
 SAM("com1","HHLOW") = sum(ig, consume(ig,"low"));
 SAM("com1","HHMED") = sum(ig, consume(ig,"med"));
 SAM("com1","HHHI") = sum(ig, consume(ig,"hi"));

 SAM("com1","FED") = sum(ig, govdemand(ig,"fed"));
 SAM("com1","NONED") = sum(ig, govdemand(ig,"ned"));
 SAM("com1","EDU") = sum(ig, govdemand(ig,"ed"));
 SAM("com1","SAVINV") = sum(ig, invdemand(ig));

 SAM("com433","IND1") = sum((is,ig), intermed(is,ig));
 SAM("com433","IND433") = sum((is,js), intermed(is,js));
 SAM("com433","HHLOW") = sum(is, consume(is,"low"));
 SAM("com433","HHMED") = sum(is, consume(is,"med"));
 SAM("com433","HHHI") = sum(is, consume(is,"hi"));
 SAM("com433","FED") = sum(is, govdemand(is,"fed"));
 SAM("com433","NONED") = sum(is, govdemand(is,"ned"));
 SAM("com433","EDU") = sum(is, govdemand(is,"ed"));
 SAM("com433","SAVINV") = sum(is, invdemand(is));

 SAM("ind1","com1") = sum(ig, make(ig));
 SAM("ind1","curracc") = sum(ig, exports(ig));

 SAM("ind433","com433") = sum(is, make(is));
 SAM("ind433","curracc") = sum(is, exports(is));

 SAM("ENTER","capital") = eta * facincome("cap");
 SAM("ENTER","FINANCE") = exoincome;

 SAM("HHLOW","LABOR") = sum(i, WMAT("low",i)*(labincome(i)
                        *(1- sum(gov, sstaxr(gov)))
                        - resadj(i)));

 SAM("HHLOW","PROP") = HHFY("low","propr") * facincome("propr");
 SAM("HHLOW","ENTER") = entdis("low") * (entincome - retearn);
 SAM("HHLOW","FED") = transfers("fed","low");
 SAM("HHLOW","NONED") = transfers("ned","low");
 SAM("HHLOW","FINANCE") = privtrans("low");

 SAM("HHMED","LABOR") = sum(i, WMAT("med",i)*(labincome(i)
                        *(1- sum(gov, sstaxr(gov)))
                        - resadj(i)));

 SAM("HHMED","PROP") = HHFY("med","propr") * facincome("propr");
 SAM("HHMED","ENTER") = entdis("med") * (entincome - retearn);
 SAM("HHMED","FED") = transfers("fed","med");
 SAM("HHMED","NONED") = transfers("ned","med");
```

```
SAM("HHHI","LABOR") = sum(i, WMAT("hi",i)*(labincome(i)
                      *(1- sum(gov, sstaxr(gov)))
                      - resadj(i)));

SAM("HHHI","PROP") = HHFY("hi","propr") * facincome("propr");
SAM("HHHI","ENTER") = entdis("hi") * (entincome - retearn);
SAM("HHHI","FED") = transfers("fed","hi");
SAM("HHHI","NONED") = transfers("ned","hi");

SAM("FED","LABOR") = sstax("fed");
SAM("FED","CAPITAL") = corptax("fed");
SAM("FED","com1") = sum(ig, govsales("fed",ig));
SAM("FED","com433") = sum(is, govsales("fed",is));
SAM("FED","IND1") = sum(ig, ibtax("fed",ig));
SAM("FED","IND433") = sum(is, ibtax("fed",is));
SAM("FED","HHLOW") = hhtax("fed","low");
SAM("FED","HHMED") = hhtax("fed","med");
SAM("FED","HHHI") = hhtax("fed","hi");
SAM("FED","FINANCE") = fedflow;

SAM("NONED","LABOR") = sstax("ned");
SAM("NONED","CAPITAL") = corptax("ned");
SAM("NONED","com1") = sum(ig, govsales("ned",ig));
SAM("NONED","com433") = sum(is, govsales("ned",is));
SAM("NONED","IND1") = sum(ig, ibtax("ned",ig));
SAM("NONED","IND433") = sum(is, ibtax("ned",is));
SAM("NONED","HHLOW") = hhtax("ned","low");
SAM("NONED","HHMED") = hhtax("ned","med");
SAM("NONED","HHHI") = hhtax("ned","hi");
SAM("NONED","FED") = fedned;
SAM("NONED","FINANCE") = nedflow;

SAM("EDU","IND1") = sum(ig, ibtax("ed",ig));
SAM("EDU","IND433") = sum(is, ibtax("ed",is));
SAM("EDU","HHLOW") = hhtax("ed","low");
SAM("EDU","HHMED") = hhtax("ed","med");
SAM("EDU","HHHI") = hhtax("ed","hi");
SAM("EDU","FED") = feded;
SAM("EDU","NONED") = neded;

SAM("SAVINV","HHLOW") = savings("low");
SAM("SAVINV","HHMED") = savings("med");
SAM("SAVINV","HHHI") = savings("hi");
SAM("SAVINV","FINANCE") = exosave;

SAM("CURRACC","labor") = sum(i, resadj(i));
SAM("CURRACC","capital") = capadj;
SAM("CURRACC","com1") = sum(ig, imports(ig));
SAM("CURRACC","com433") = sum(is, imports(is));
SAM("CURRACC","ind1") = sum(ig, ncimpi(ig));
SAM("CURRACC","ind433") = sum(is, ncimpi(is));
SAM("CURRACC","HHLOW") = ncimpc("low");
SAM("CURRACC","HHMED") = ncimpc("med");
SAM("CURRACC","HHHI") = ncimpc("hi");

SAM("FINANCE","capital") = deprec;
SAM("FINANCE","enter") = retearn;
SAM("FINANCE","CURRACC") = cadeficit;

SAM("TOTAL","LABOR")     = SUM(isam2,SAM(isam2,"LABOR")) ;
SAM("TOTAL","PROP")      = SUM(isam2,SAM(isam2,"PROP")) ;
SAM("TOTAL","CAPITAL")   = SUM(isam2,SAM(isam2,"CAPITAL")) ;
SAM("TOTAL","COM1")      = SUM(isam2,SAM(isam2,"COM1")) ;
SAM("TOTAL","COM433")    = SUM(isam2,SAM(isam2,"COM433")) ;
SAM("TOTAL","IND1")      = SUM(isam2,SAM(isam2,"IND1")) ;
SAM("TOTAL","IND433")    = SUM(isam2,SAM(isam2,"IND433")) ;
SAM("TOTAL","ENTER")     = SUM(isam2,SAM(isam2,"ENTER")) ;
SAM("TOTAL","HHLOW")     = SUM(isam2,SAM(isam2,"HHLOW")) ;
SAM("TOTAL","HHMED")     = SUM(isam2,SAM(isam2,"HHMED")) ;
```

```
SAM("TOTAL","HHHI")      = SUM(isam2,SAM(isam2,"HHHI")) ;
SAM("TOTAL","FED")       = SUM(isam2,SAM(isam2,"FED")) ;
SAM("TOTAL","NONED")     = SUM(isam2,SAM(isam2,"NONED")) ;
SAM("TOTAL","EDU")       = SUM(isam2,SAM(isam2,"EDU")) ;
SAM("TOTAL","SAVINV")    = SUM(isam2,SAM(isam2,"SAVINV")) ;
SAM("TOTAL","CURRACC")   = SUM(isam2,SAM(isam2,"CURRACC")) ;
SAM("TOTAL","FINANCE")   = SUM(isam2,SAM(isam2,"FINANCE")) ;
SAM(isam3,"TOTAL")       = SUM(isam2,SAM(isam3,isam2)) ;

* ADJUSTMENTS IN SAVINV AND CURRACC TO BALANCE SAM

PARAMETER  ROWSUM(isam)  ROW SUMS OF SAM ACCOUNTS;
  ROWSUM(isam) = SAM(isam,"TOTAL");

PARAMETER  COLSUM(isam)  COLUMN SUMS OF SAM ACCOUNTS;
  COLSUM(isam) = SAM("TOTAL",isam);

DISPLAY intermed, labincome, propincome, capincome, valadd, imports,
        ncimpc, ncimpi, output, consume, exoincome, facincome,
        entincome, resadj, deprec, capadj, retearn, savings,
        govdemand, govsales, fedflow, fedned, feded, neded,
        invdemand, exports, cadeficit, make, absorb, exosave,
        SAM, ROWSUM, COLSUM ;

*    ///////////////////////////   ASSIGN   SHORT   LABELS
/////////////////////////////
PARAMETER

Qo(i)     benchmark total regional absorption
Xo(i)     benchmark regional output
Co(i,hh)     benchmark household consumption
GTOTo(gov)  total commod purchases by govt sectors
ITOTo     benchmark total investment
Eo(i)     benchmark industry exports
Mo(i)     benchmark commodity imports
ERo    exchange rate (cost of regional goods i.t.o. imps. or exps.)
TRANSo(gov,hh)  benchmark govt transfers to households
PTRANSo(hh)     benchmark net private income transfers
;
Qo(i)     = absorb(i);
Xo(i)     = OUTPUT(I);
Co(i,hh) = CONSUME(i,hh);
GTOTo(gov) = sum(i, govdemand(i,gov));
ITOTo     = sum(i, invdemand(i));
Eo(i)     = exports(i);
Mo(i)     = imports(i);
ERo       = 1.0;
TRANSo(gov,hh)  = transfers(gov,hh);
PTRANSo(hh)     = privtrans(hh);

*    /////////////////////   CALCULATE   MODEL   PARAMETERS
///////////////////////////

PARAMETER
  a(i,j)              import-ridden regional I-O coefficients
  NDo(I)              benchmark intermed. demand for commods. by indus.
  BUSSo(i)            benchmark industry property assessment value
  bustaxr(gov,i)      INDUSTRY PROPERTY TAX RATES
  BUTAXo(gov,i)       benchmark commercial property taxes
  extaxr(gov,i)       SALES AND EXCISE TAX RATE PAID BY INDUSTRIES
  EXCTAXo(gov,i)      benchmark SALES AND EXCISE TAXES PAID BY INDUS
  ITAXo(gov,i)        benchmark ind. bus. tax receipts
  Vo(I)               benchmark nominal value added excluding ibt
  Po(I)               composite commodity prices (ie. PRICE OF Qo(I))
  pm                  import price
  pe                  export price
  invr(i)             regional investment shares
  ITo(i)              benchmark investment expenditure on commod. i
```

```
gdr(i,gov)          regional govt. purchase shares
Go(i,gov)           benchmark government commodity purchases
XXDo(I)             benchmark absorption of regional  production
govsalesr(gov,i)    proportion of non-indus. supply in absorption
GSo(gov,i)          benchmark non-industrial supply
PDo(I)              benchmark price of regionally produced goods
PXo(I)              benchmark average output price
ncimpir(i)          non-comparable import share of total output
INDIMPo(i)          bench. non-comp. imports by industry
PVo(I)              benchmark domestic value-added prices
sigma(i)            elasticity of substitution (Armington function exponent)
del(i)              temporary parameter used to calculate delta(i)
delta(i)            armington function share parameter
ac(i)               armington function shift parameter
tau(i)              transformation elasticity (CET function exponent)
gamma(i)            CET function share parameter
at(i)               CET function shift parameter
WSTARo              benchmark wage rate (gross of payroll taxes)
Lo(I)               benchmark industry labor demand (employment)
Wo                  benchmark net wage (i.e. net of payroll taxes)
STAXo(gov)          benchmark payroll tax payments
LABYo(i)            benchmark net reg. labor earnings (net of payroll tax)
RADJo(i)            benchmark net labor earnings paid to non-res. labor
resadjr             prop. of net lab. earnings paid to non-res. labor
LTOTo               benchmark regional labor supply
PPo                 benchmark unit rate of return to proprietors
Fo(I)               benchmark industry demand for proprietors' services
PROPYo              benchmark regional proprietors' income
FTOTo               benchmark regional supply of proprietors' services
RSTARo              benchmark cap. rental rate (incl. corp taxes and deprec)
Ko(I)               benchmark industry demand for capital services
Ro                  benchmark net rental rate (net of corp. taxes and deprec.)
CTAXo(gov)          benchmark capital tax rates
capadjr             propor. of net cap. earnings paid to non-res. owners
CADJo               benchmark capital adjustment
DEPo                benchmark capital depreciation
CAPYo               benchmark net regional capital income
KTOTo               benchmark regional capital supply
retearnr            enterprise savings rate
ENTYo               benchmark regional enterprise income
RETo                benchmark enterprise savings
HHLABYo(hh)         benchmark net household labor income
HHPROPYo(hh)        benchmark net household proprietors' income
HHENTYo(hh)         benchmark net household enterprise income
HHYo(hh)            benchmark regional household income
HHSSo(hh)           baseline household property assessments
PROTAXo(gov,hh)     baseline household property taxes
ADJINCo(gov,hh)     baseline taxable income
INCTAXXo(gov,hh)    baseline household income taxes
HTAXo(gov,hh)       benchmark total household tax payments
HHYDo(hh)           benchmark disposable household income
cshare(i,hh)        LES expenditure shares
ncimpcr(hh)         proportion of con-comp. imps. in hh consump.
HHIMPo(hh)          benchmark household non-comp. imports
sshare(hh)          household savings share of dispos. income
HHSAVo(hh)          benchmark net household savings
lshare(i)           CD production function labor share exponent
fshare(i)           CD production function proprietors' share exponent
kshare(i)           CD production function capital share exponent
av(i)               CD production function shift coefficient
FEDFLOWo            benchmark transfers to regional federal govt
NEDEDo              benchmark transfers from s&l general fund for education
NEDFLOWo            benchmark "other revenues" of state & local govt
CADEFo              benchmark current account deficit
EXOSAVo             benchmark exogenous saving (balancing item for SAVINV);

a(i,j) = intermed(i,j) / Xo(j);
NDo(I) = SUM(j, a(i,j)*Xo(J));
BUSSo(i) = indassess(i);
```

```
bustaxr(gov,i)$(BUSSo(i) NE 0) = bustax(gov,i) / BUSSo(i) ;
BUTAXo(gov,i) = bustaxr(gov,i) * BUSSo(i);
extaxr(gov,i) = extax(gov,i) / Xo(i);
EXCTAXo(gov,i) = extaxr(gov,i) * Xo(i);
ITAXo(gov,i) = BUTAXo(gov,i) + EXCTAXo(gov,i);
Vo(I) = LABINCOME(I) + PROPINCOME(I) + CAPINCOME(I);
Po(i)   = 1.0;
pm = 1.0;
pe = 1.0;
invr(i) = invdemand(i) / ITOTo;
ITo(i) = invr(i)*ITOTo / Po(i);
gdr(i,gov) = govdemand(i,gov) / GTOTo(gov);
Go(i,gov) = gdr(i,gov)*GTOTo(gov);
XXDo(I) = Xo(I) - Eo(I);
govsalesr(gov,i) = govsales(gov,i) / Qo(i);
GSo(gov,i) = govsalesr(gov,i)*Qo(i);
Qo(i) = XXDo(i) + Mo(i) + sum(gov, GSo(gov,i));
PDo(I) = (Po(i)*Qo(i) - pm*ERo*Mo(I)) / (XXDo(i)+ sum(gov, GSo(gov,i)));
PXo(I) = (PDo(I)*XXDo(I) + pe*ERo*Eo(I)) / Xo(I);
ncimpir(i) = ncimpi(i) / Xo(i);
INDIMPo(i) = ncimpir(i) * Xo(i) * PXo(i) / pm*ERo;
PVo(I) = PXo(I)* (1 - sum(gov, ITAXo(gov,i)/(PXo(i)*Xo(i))) - ncimpir(i))
         - sum(j, a(j,i) * Po(J));
sigma(ig) = 1.5;
sigma(is) = 0.4;
del(i) = PM/PDo(I)*(Mo(I)/XXDo(I))**(1/sigma(i));
delta(i) = del(i)/(1+del(i));
ac(i) = (Qo(i)-sum(gov,GSo(gov,i)))/(delta(i)*Mo(I)**((sigma(i)-1)/sigma(i))
   +(1-delta(i))*XXDo(I)**((sigma(i)-1)/sigma(i)))**(sigma(i)/(sigma(i)-1));
tau(ig) = 1.5;
tau(is) = 0.4;
gamma(i) = 1 / (1 + PDo(I)/pe * (Eo(I)/XXDo(I))**(1/tau(i)));
at(i) = Xo(I)/(gamma(i)*Eo(I)**((tau(i)+1)/tau(i))
      +(1-gamma(i))*XXDo(I)**((tau(i)+1)/tau(i)))**(tau(i)/(tau(i)+1));
WSTARo = 1.0;
Lo(I) = LABINCOME(I) / WSTARo;
Wo = WSTARo * (1 - sum(gov, sstaxr(gov)));
STAXo(gov) = sstaxr(gov) * sum(i, Lo(i))*WSTARo;
LABYo(i) = Lo(i)*Wo - resadj(i);
RADJo(i) = Lo(i)*Wo - LABYo(i);
resadjr = sum(i, RADJo(i)) / sum(i, Lo(i) * Wo);
LTOTo = SUM(I,Lo(I));
PPo = 1.0;
Fo(I) = PROPINCOME(I) / PPo;
PROPYo = sum(i, Fo(i) * PPo);
FTOTo = SUM(I,Fo(I));
RSTARo = 1.0;
Ko(I) = CAPINCOME(I) / RSTARo;
Ro = RSTARo * (1 - sum(gov, corptaxr(gov)) - depr);
CTAXo(gov) = corptaxr(gov)*sum(i, Ko(i))*WSTARo;
capadjr = capadj / sum(i, Ko(i) * Ro) ;
CADJo = capadjr * sum(i, Ko(i) * Ro) ;
DEPo = depr * sum(i, Ko(i)*RSTARo);
CAPYo = (1 - capadjr) * sum(i, Ko(i) * Ro) ;
KTOTo = SUM(I,Ko(I));
retearnr = retearn / (CAPYo + exoincome);
ENTYo = (1 - retearnr) * (CAPYo + exoincome);
RETo = retearnr * (CAPYo + exoincome);
HHLABYo(hh) =  sum(i, WMAT(HH,I)*LABYo(i));
HHPROPYo(hh) = HHFY(hh,"propr") * PROPYo;
HHENTYo(hh) = entdis(hh) * ENTYo;
HHYo(hh) = HHLABYo(hh) + HHPROPYo(hh) + HHENTYo(hh)
          + sum(gov, TRANSo(gov,hh)) + PTRANSo(hh);
HHSSo(hh) = hhassess(hh);
PROTAXo(gov,hh) = proptaxr(gov) * HHSSo(hh);
ADJINCo("fed",hh) = HHYo(hh) - sum(gov, PROTAXo(gov,hh));
INCTAXXo("fed",hh) = inctaxr("fed",hh) * ADJINCo("fed",hh);
ADJINCo("ned",hh) = HHYo(hh) - INCTAXXo("fed",hh);
ADJINCo("ned","hi") = HHYo("hi");
```

```
INCTAXXo("ned",hh) = inctaxr("ned",hh) * ADJINCo("ned",hh);
INCTAXXo("ed",HH) = 0;
HTAXo(gov,hh) = PROTAXo(gov,hh) + INCTAXXo(gov,hh);
HHYDo(hh) = HHYo(hh) - sum( gov, HTAXo(gov,hh));
cshare(i,hh) = Co(i,hh)*Po(i) / HHYDo(hh);
ncimpcr(hh) = ncimpc(hh) / HHYDo(hh);
HHIMPo(hh) = ncimpcr(hh) * HHYDo(hh) / pm*ERo;
sshare(hh) = 1 - sum(i, cshare(i,hh)) - ncimpcr(hh);
HHSAVo(hh) = HHYDo(hh) * sshare(hh);
lshare(i) = (WSTARo*Lo(I)) / (PVo(i)*Xo(i));
fshare(i) = (PPo*Fo(I)) / (PVo(i)*Xo(i));
kshare(i) = 1 - lshare(i) - fshare(i);
av(i) = Xo(I) / (Lo(I)**lshare(i) * Fo(I)**fshare(i) * Ko(I)**kshare(i));
FEDFLOWo = sum(i, Go(i,"fed") * Po(i)) + sum(hh, TRANSo("fed",hh))
           + fedned + feded - STAXo("fed") - CTAXo("fed")
           - sum(i, GSo("fed",i) * PDo(i)) - sum(i, ITAXo("fed",i))
           - sum(hh, HTAXo("fed",hh));
NEDEDo = sum(i, Go(i,"ed")*Po(i)) - sum(i, ITAXo("ed",i))
           - sum(hh, HTAXo("ed",hh)) - feded;
NEDFLOWo = sum(i, Go(i,"ned")*Po(i)) + sum(hh, TRANSo("ned",hh))
           + NEDEDo - STAXo("ned") - CTAXo("ned")
           - sum(i, GSo("ned",i) * PDo(i))
           - sum(i, ITAXo("ned",i)) - sum(hh, HTAXo("ned",hh)) - fedned;
CADEFo = sum(i, RADJo(i)) + CADJo + sum(i, Mo(i)*pm)
        + sum(i, INDIMPo(i)*pm)+ sum(hh, HHIMPo(hh)) - SUM(i, Eo(i) * pe);

EXOSAVo = sum(i, ITo(i) * Po(i)) - sum(hh, HHSAVo(hh));

OPTION a:6, cshare:6, sshare:6, lshare:6, fshare:6, kshare:6, wo:6, ppo:6;
DISPLAY  a, av, ac, at, delta, gamma, sigma, tau,
         lshare, fshare, kshare, cshare, sshare,
         sstaxr, corptaxr, govsalesr, depr, retearnr,
         bustaxr, BUTAXo, extaxr, EXCTAXo, ITAXo, BUSSo,
         Po, PXo, PDo, PVo, pm, pe,
         Qo, Xo, XXDo, Vo, Mo, Eo, NDo, Co, Go, ITo, ITOTo, invr,
         WSTARo, Wo, PPo, RSTARo, Ro, Lo, Fo, Ko, LTOTo, FTOTo, KTOTo,
         STAXo, CTAXo, RADJo, CADJo, GSo, ITAXo, INDIMPo, DEPo, RETo,
         proptaxr, PROTAXo, inctaxr, INCTAXXo, HTAXo, HHSSo,
         HHIMPo, HHYDo,
         LABYo, PROPYo, CAPYo, ENTYo, HHLABYo, HHPROPYo, HHENTYo, TRANSo,
         HHYo,  HHSAVo, fedned, feded, FEDFLOWo, NEDEDo, NEDFLOWo,
         ncimpir, ncimpcr, CADEFo, EXOSAVo,
         exoincome ;

* ################## BENCHMARK REPLICATION OF MODEL ##################

PARAMETER
 Qoo(i)
 Qooo(i)
 Woo(i)
 WSTARoo(i)
 PPoo(i)
 RSTARoo(i)
 Roo(i)
 PVoo(I)
 Xoo(I)
 Xooo(I)
 PXoo(I)
 Eoo(I)
 NDoo(I)
 Coo(i,hh)
 XXDoo(I)
 Poo(I)
 Moo(I)
 LABYoo(i)
 RADJoo(i)
 RJoo
 PROPYoo
 CAPYoo
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ENTYoo
HHYoo
BUTAXoo
EXCTAXoo
ITAXoo
PROTAXoo
ADJINCoo
INCTAXXoo
HTAXoo
HHYDoo
HHSAVoo
FEDFLOWoo
NEDEDoo
NEDFLOWoo
CADEFoo
EXOSAVoo
;
Xoo(i) = av(i) * Lo(i)**lshare(i) * Fo(i)**fshare(i) * Ko(i)**kshare(i);
WSTARoo(i) = PVo(i) * lshare(i) * Xo(i)/Lo(i);
PPoo(i)$Fo(i) = PVo(i) * fshare(i) * Xo(i)/Fo(i);
PPoo("GOVT") = 1.0;
RSTARoo(i) = PVo(i) * kshare(i) * Xo(i)/Ko(i);

Woo(i) =  WSTARoo(i) * (1 - sum(gov, sstaxr(gov)));
Roo(i) = RSTARoo(i) * (1 - sum(gov, corptaxr(gov)) - depr);
Qoo(i) = ac(i)*(delta(i)*Mo(i)**((sigma(i)-1)/sigma(i))
   +(1-delta(i))*XXDo(i)**((sigma(i)-1)/sigma(i)))**(sigma(i)/(sigma(i)-1))
   + sum(gov, GSo(gov,i));
Poo(i) = (PDo(i)*(XXDo(i) + sum(gov, GSo(gov,i))) + pm*ERo*Mo(i)) / Qo(i);
Moo(i) = XXDo(i) * (PDo(i)/pm * delta(i)/(1-delta(i)))**sigma(i);
Xooo(i) = at(i)*(gamma(i)*Eo(i)**((tau(i)+1)/tau(i))
          +(1-gamma(i))*XXDo(i)**((tau(i)+1)/tau(i)))**(tau(i)/(tau(i)+1));
PXoo(i) = (PDo(i)*XXDo(i) + pe*ERo*Eo(i))/Xo(i);
Eoo(i) = XXDo(i) * (PE/PDo(i)*(1-gamma(i))/gamma(i))**tau(i);
NDoo(i) = SUM(j, a(i,j) * Xo(j) * Poo(i));
Coo(i,hh) = cshare(i,hh)/Po(i) * HHYDo(hh);
Qooo(i) = NDoo(i) + sum(hh, Coo(i,hh)) + ITo(i) + sum(gov, Go(i,gov));
LABYoo(i) = (1 - resadjr) * Lo(i) * Woo(i);
RADJoo(i) = resadjr * Lo(i) * Woo(i);
RJoo      = sum(i, RADJoo(i));
PROPYoo = sum(i, Fo(i) * PPoo(i));
CAPYoo = (1 - capadjr) * sum(i, Ko(i) * Roo(i));
ENTYoo = (1 - retearnr) * (CAPYoo + exoincome);
HHYoo(hh) = sum(i, WMAT(HH,I)*LABYoo(i)) + HHFY(hh,"propr")*PROPYoo
          + entdis(hh)*ENTYoo + sum(gov, TRANSo(gov,hh)) + PTRANSo(hh);
BUTAXoo(gov,i) = bustaxr(gov,i) * BUSSo(i);
EXCTAXoo(gov,i) = extaxr(gov,i) * Xoo(i);
ITAXoo(gov,i) = BUTAXoo(gov,i) + EXCTAXoo(gov,i);

PVoo(i) = PXo(I)*(1 - sum(gov, ITAXoo(gov,i)/(PXoo(i)*Xoo(i))) - ncimpir(i))
          - SUM(j, a(j,i) * Po(j));
PROTAXoo(gov,hh) =  proptaxr(gov) * HHSSo(hh);
ADJINCoo("fed",hh) = HHYoo(hh) - sum(gov, PROTAXoo(gov,hh));
INCTAXXoo("fed",hh) = inctaxr("fed",hh) * ADJINCoo("fed",hh);
ADJINCoo("ned",hh) = HHYoo(hh) - INCTAXXoo("fed",hh);
ADJINCoo("ned","hi") = HHYoo("hi");
INCTAXXoo("ned",hh) = inctaxr("ned",hh) * ADJINCoo("ned",hh);
INCTAXXoo("ed",HH) = 0;
HTAXoo(gov,hh) = PROTAXoo(gov,hh) + INCTAXXoo(gov,hh);
HHYDoo(hh) = HHYoo(hh) - sum(gov, HTAXoo(gov,hh));
HHSAVoo(hh) = HHYDoo(hh) * sshare(hh);
FEDFLOWoo = sum(i, Go(i,"fed")*Poo(i)) + sum(hh, TRANSo("fed",hh))
            + fedned + feded - sstaxr("fed")*sum(i, Lo(i) * WSTARoo(i))
            - corptaxr("fed")*sum(i, Ko(i) * RSTARoo(i))
            - sum(i, govsalesr("fed",i)*Qoo(i))
            - sum(i, ITAXoo("fed",i))
            - sum(hh, HTAXoo("fed",hh));

NEDEDoo = sum(i, Go(i,"ed")*Poo(i)) - sum(i, ITAXoo("ed",i))
```

```
           - sum(hh, HTAXoo("ed",hh)) - feded;
 NEDFLOWoo = sum(i, Go(i,"ned")*Poo(i)) + sum(hh, TRANSo("ned",hh))
             + NEDEDoo - sstaxr("ned")*sum(i, Lo(i) * WSTARoo(i))
             - corptaxr("ned")*sum(i, Ko(i) * RSTARoo(i))
             - sum(i, govsalesr("ned",i)*Qoo(i) * PDo(i))
             - sum(i, ITAXoo("ned",i))
             - sum(hh, HTAXoo("ned",hh)) - fedned;
 CADEFoo = sum(i, RADJo(i)) + CADJo + SUM(i, Moo(i))*pm*ERo
         + sum(i, ncimpir(i) * Xoo(i))*pm*ERo
         + sum(hh, ncimpcr(hh)*HHYDoo(hh))*pm*ERo - SUM(i, Eoo(i))*pe*ERo;
 EXOSAVoo = sum(i, ITo(i)*Poo(i)) - sum(hh, HHSAVoo(hh));
 XXDoo(i) = Xooo(i) - Eoo(i);

DISPLAY  Qooo, Qoo, Woo, WSTARoo, PPoo, Roo, RSTARoo, PVoo, PVo,
         Xo, Xoo, Xooo, Poo, Moo, Mo, PXoo, PXo, Eoo, Eo, NDoo, NDo,
         Coo, Co, XXDo, XXDoo , LABYoo, RADJoo,RJoo,PROPYoo, CAPYoo, ENTYoo,
         HHYoo, HHYDoo, HHSAVoo,
         HHSSo, PROTAXoo, ADJINCoo, INCTAXXoo, HTAXoo,
         BUSSo, EXCTAXoo, BUTAXoo, ITAXoo,
         FEDFLOWoo, NEDEDoo, NEDFLOWoo, CADEFoo, EXOSAVoo;

*#####################################################################
VARIABLES
*#####################################################################
LTOT              total regional labor supply
FTOT              total regional supply of proprietors' services
KTOT              total regional supply of capital
L(i)              industry demand for labor
F(i)              industry demand for proprietors' services
K(i)              industry demand for capital
Q(i)              total commod supply (incl govsales)
X(i)              industry output (composite of XXD(i) and E(i))
C(i,hh)           consumption of commodities by households
G(i,gov)          government purchases of commodities
GTOT(gov)         total govt commod purchases
ITOT              total investment
IT(i)             investment expenditure on commodities
ND(i)             intermediate demand for commodities by industries
E(i)              exports of industry output
M(i)              imports of commodities
XXD(i)            regional industry production for regional use
WSTAR             gross unit labor cost
W                 net wage
PP                unit return to proprietors
RSTAR             gross unit cost of capital
R                 net capital rental rate
STAX(gov)         payroll tax receipts
RADJ(i)           net residence adjustment
CTAX(gov)         capital tax receipts
CADJ              net capital adjustment
BUTAX(gov,i)      industry property taxes
EXCTAX(gov,i)     industry sales and excise taxes
ITAX(gov,i)       indirect business tax receipts
INDIMP(i)         non-comp. imports by industry
GS(gov,i)         non-industrial commod. supply
FEDINC(hh)        adjusted fed taxable income
NEDINC(hh)        adjusted ned taxable income
PROTAX(gov,hh)    property tax receipts from households
INTAXR(hh)        ned income tax rates
INCTAXX(gov,hh)   income tax receipts from households
HTAX(gov,hh)      total tax receipts from households
HHIMP(hh)         non-comp. imports by household
P(i)              price of composite commodity (price of Q(i))
PV(i)             value-added prices (net of IBT and intermed. demand)
PD(i)             price of regionally-produced goods (price of XXD(i))
PX(i)             average price of industry output (price of X(i))
LABY(i)           net regional labor earnings
PROPY             net regional proprietors' earnings
CAPY              net regional capital income
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ENTY          net regional enterprise income
HHY(hh)       regional household income
HHYD(hh)      regional disposable income
HHSAV(hh)     net household savings
EXOSAV        exogenous "foreign" savings
FEDFLO        federal government budget deficit
EDTRANS       transfers from s&l general fund to education
NEDFLO        other s&l revenues (misc. taxes and interest)
CADEF         current account deficit
ER            "exchange rate" variable to balance current account
OMEGA         objective function variable;

*########################VARIABLE INITIALIZATION####################
LTOT.L     = LTOTo;
FTOT.L     = FTOTo;
KTOT.L     = KTOTo;
L.L(i)     = Lo(i);
F.L(i)     = Fo(i);
K.L(i)     = Ko(i);
Q.L(i)     = Qo(i);
X.L(i)     = Xo(i);
C.L(i,hh)  = Co(i,hh);
G.L(i,gov) = Go(i,gov);
GTOT.L(gov) = GTOTo(gov);
ITOT.L      = ITOTo;
IT.L(i)    = ITo(i);
ND.L(i)    = NDo(i);
E.L(i)     = Eo(i);
M.L(i)     = Mo(i);
XXD.L(i)   = XXDo(i);
WSTAR.L    = WSTARo;
W.L        = Wo;
PP.L       = PPo;
RSTAR.L    = RSTARo;
R.L        = Ro;
STAX.L(gov) = STAXo(gov);
RADJ.L(i)   = RADJo(i);
CTAX.L(gov) = CTAXo(gov);
CADJ.L      = CADJo;
BUTAX.L(gov,i)  = BUTAXo(gov,i);
EXCTAX.L(gov,i) = EXCTAXo(gov,i);
ITAX.L(gov,i)   = ITAXo(gov,i);
INDIMP.L(i)     = INDIMPo(i);
GS.L(gov,i)     = GSo(gov,i);
FEDINC.L(hh)    = ADJINCo("fed",hh);
NEDINC.L(hh)    = ADJINCo("ned",hh);
PROTAX.L(gov,hh) = PROTAXo(gov,hh);
INTAXR.L(hh) = inctaxr("ned",hh);
INCTAXX.L(gov,hh)  = INCTAXXo(gov,hh);
HTAX.L(gov,hh) = HTAXo(gov,hh);
HHIMP.L(hh)     = HHIMPo(hh);
P.L(i)     = Po(i);
PV.L(i)    = PVo(i);
PD.L(i)    = PDo(i);
PX.L(i)    = PXo(i);
LABY.L(i)  = LABYo(i);
PROPY.L    = PROPYo;
CAPY.L     = CAPYo;
ENTY.L     = ENTYo;
HHY.L(hh)     = HHYo(hh);
HHYD.L(hh)    = HHYDo(hh);
HHSAV.L(hh)   = HHSAVo(hh);
EXOSAV.L      = EXOSAVo;
FEDFLO.L      = FEDFLOWo;
EDTRANS.L     = NEDEDo;
NEDFLO.L      = NEDFLOWo;
CADEF.L       = CADEFo;
ER.L = ERo;
```

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*###################################################################
EQUATIONS
*###################################################################
PRODFCN(I)     C-D production functions determining industry output
FOCLAB(I)      f.o.c. determining labor wage rate
FOCPROP(I)     f.o.c. determining rate of return for proprietors' services
FOCCAP(I)      f.o.c. determining capital rental rate
NETWAGE        definition of net wage
NETRENT        definition of net capital rental rate
PVALADD(I)     definition of regional value-added prices
SOCTAX(gov)     payroll tax receipts
CAPTAX(gov)     capital tax receipts
RESLAB(i)       definition of residence adjustment
RESCAP          definition of capital adjustment
BUSINESS(gov,i) industry property taxes
EXCISE(gov,i)    industry sales and excise taxes
INDTAX(gov,i)    industry indirect taxes
IIMP(i)            non-comparble imports by industry
PROPERTYT(gov,hh)  household property tax collections
FINC(hh)           adjusted income for computing fed income tax
*NINC(hh)           adjusted income for computing ned income tax
NINCL              adjusted income for computing lowhhs ned income tax
NINCM              adjusted income for computing medhhs ned income tax
NINCH              adjusted income for computing hihhs ned income tax
FINCOMET(hh)       fed income tax payments
NINCOMET(hh)       ned income tax payments
HOUSETAX(gov,hh)   total houshold tax collections
HIMP(hh)           non-comparable imports by households
GOVSUP(gov,i)      total non-industrial commodity supply
ARMINGTON(I)   definition of composite absorption commodity
BUDGET(I)      budget constraint on commodity absorption
IMPORT(I)      ratio of commodity imports to domestic commodity supply
CET(I)         transformation of industry output
REVENUE(I)     industry revenue function
EXPORT(I)      ratio of industry exports to domestic commodity demand
INTDEM(I)      definition of intermediate demand
CONSUM(I,HH)   definition of household consumption
GDSMKTEQ(I)    goods market equilibrium condition
LABINCOM(i)    definition of regional labor income by P.O.R.
PROPINCOM      def. of reg. proprietors' income by P.O.R.
CAPINCOM       def. of regional capital income by P.O.R.
ENTINCOM       def. of regional enterprise income
INCOME(hh)     definition of regional hh income
DISINCOME(hh)  regional hh disposable income
CURRACCT       definition of foreign savings
TOTGOV(i,gov)   definition of total govt commod purchases
FEDDEF         definition of regional federal govt "deficit"
NEDDEF         s&l govt "other revenue"
EDDEF          general fund flows to education
TOTINV(i)         definition of total physical investment
SAVINVEQ       saving-investment equilibrium condition
*FINANCE         external capital account equilibrium condition
LABMKTEQ       labor market equilibrium condition
PROPMKTEQ      equilibrium condition in market for proprietors' services
CAPMKTEQ       capital market equilibrium condition
OBJ            objective function;

*    ########################                MODEL     EQUATIONS
############################
PRODFCN(i).. X(i) =E= av(i)*L(i)**lshare(i)*F(i)**fshare(i)*K(i)**kshare(i);
FOCLAB(i)..    WSTAR  =E= PV(i) * lshare(i)*X(i)/L(i);
FOCPROP(i)..    PP*F(i) =E= PV(i) * fshare(i)*X(i);
FOCCAP(i)..    RSTAR  =E= PV(i) * kshare(i)*X(i)/K(i);
NETWAGE..      W =E= WSTAR * (1 - sum(gov, sstaxr(gov)));
NETRENT..      R =E= RSTAR * (1 - sum(gov, corptaxr(gov)) - depr);
PVALADD(i)..  PV(i) =E= PX(i)*(1 - sum(gov, ITAX(gov,i) / (PX(i)*X(i)))
                         - ncimpir(i)) - sum(j, a(j,i)*P(j));
SOCTAX(gov)..  STAX(gov) =E= sstaxr(gov) * sum(i, L(i))*WSTAR;
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```
CAPTAX(gov)..  CTAX(gov) =E= corptaxr(gov) * sum(i, K(i))*RSTAR;
RESLAB(i)..    RADJ(i) =E= resadjr * L(i)*W;
RESCAP..       CADJ =E= capadjr * sum(i, K(i))*R;
BUSINESS(gov,i)..   BUTAX(gov,i)  =E= bustaxr(gov,i) * BUSSo(i);
EXCISE(gov,i)..     EXCTAX(gov,i) =E= extaxr(gov,i) * X(i);
INDTAX(gov,i)..     ITAX(gov,i) =E= BUTAX(gov,i) + EXCTAX(gov,i);
IIMP(i)..           INDIMP(i) =E= ncimpir(i) * X(i) * PX(i) / pm*ER;
PROPERTYT(gov,hh).. PROTAX(gov,hh) =E= proptaxr(gov) * HHSSo(hh);
FINC(hh)..  FEDINC(hh) =E= HHY(hh) - sum(gov, PROTAX(gov,hh));
*NINC(hh)..  NEDINC(hh) =E= HHY(hh) - INCTAXX("fed",hh);
NINCL..     NEDINC("low") =E= HHY("low") - INCTAXX("fed","low");
NINCM..     NEDINC("med") =E= HHY("med") - INCTAXX("fed","med");
NINCH..     NEDINC("hi") =E= HHY("hi");
FINCOMET(hh).. INCTAXX("fed",hh) =E= inctaxr("fed",hh) * FEDINC(hh);
NINCOMET(hh).. INCTAXX("ned",hh) =E= INTAXR(hh) * NEDINC(hh);
*EINCOMET(hh)..  INCTAXX("ed",hh) =E= inctaxr("ed",hh) * HHY(hh);
HOUSETAX(gov,hh)..  HTAX(gov,hh) =E= PROTAX(gov,hh) + INCTAXX(gov,hh);
HIMP(hh)..          HHIMP(hh) =E= ncimpcr(hh) * HHYD(hh) / pm*ER;
GOVSUP(gov,i)..     GS(gov,I) =E= Q(i) * govsalesr(gov,i);
ARMINGTON(i).. Q(i) =E= ac(i) * (delta(i)*M(i)**((sigma(i)-1)/sigma(i))
      +(1-delta(i))*XXD(i)**((sigma(i)-1)/sigma(i)))**(sigma(i)/(sigma(i)-1))
      + sum(gov, GS(gov,i));
BUDGET(i)..  P(i)*Q(i) =E= PD(i)*(XXD(i) + sum(gov,GS(gov,i))) + pm*ER*M(i);
IMPORT(i)..  M(i) =E= XXD(i)*(PD(i)/(pm*ER)*delta(i)/(1-delta(i)))**sigma(i);
CET(i)..   X(i) =E= at(i)*(gamma(i)*E(i)**((tau(i)+1)/tau(i))
           +(1-gamma(i))*XXD(i)**((tau(i)+1)/tau(i)))**(tau(i)/(tau(i)+1));
REVENUE(i)..  PX(i)*X(i) =E= PD(i)*XXD(i) + pe*ER* E(i);
EXPORT(i)..   E(i) =E= XXD(i)*(pe*ER/PD(i) * (1-gamma(i))/gamma(i))**tau(i);
INTDEM(i)..   ND(i) =E= SUM(J, a(i,j)*X(j));
CONSUM(i,hh)..  C(i,hh) =E= cshare(i,hh)/P(i) * HHYD(hh);
GDSMKTEQ(i)..  Q(i) =E= ND(i) + sum(hh, C(i,hh)) + IT(i) + sum(gov, G(i,gov));
LABINCOM(i)..  LABY(i) =E= L(i)*W - RADJ(i);
PROPINCOM.. PROPY =E= sum(i, F(i) * PP);
CAPINCOM..  CAPY =E= sum(i, K(i))*R - CADJ;
ENTINCOM..  ENTY =E= (1 - retearnr) * (CAPY + exoincome);
INCOME(hh).. HHY(hh) =E= sum(i, WMAT(HH,I)*LABY(i)) + HHFY(hh,"propr")*PROPY
               + entdis(hh)*ENTY + sum(gov, TRANSo(gov,hh)) + PTRANSo(hh);
DISINCOME(hh)..  HHYD(hh) =E= HHY(hh) - sum(gov, HTAX(gov,hh));
CURRACCT..  CADEF =E= sum(i, RADJ(i)) + CADJ + SUM(i, M(i))*pm*ER
                   + sum(i, INDIMP(i))*pm*ER
                   + sum(hh, HHIMP(hh))*pm*ER - SUM(i, E(i))*pe*ER;
TOTGOV(i,gov)..  G(i,gov) =E= gdr(i,gov) * GTOT(gov);
FEDDEF..    FEDFLO =E= sum(i, G(i,"fed")*P(i)) + sum(hh, TRANSo("fed",hh))
                   + fedned + feded - STAX("fed") - CTAX("fed")
                   - sum(i, GS("fed",i)*PD(i)) - sum(i, ITAX("fed",i))
                   - sum(hh, HTAX("fed",hh));
NEDDEF..  NEDFLO =E= sum(i, G(i,"ned")*P(i)) + sum(hh, TRANSo("ned",hh))
                 + EDTRANS - STAX("ned") - CTAX("ned")
                 - sum(i, GS("ned",i)*PD(i)) - sum(i, ITAX("ned",i))
                 - sum(hh, HTAX("ned",hh)) - fedned;
EDDEF..   EDTRANS =E= sum(i, G(i,"ed")*P(i)) - sum(i, ITAX("ed",i))
                 - sum(hh, HTAX("ed",hh)) - feded;
TOTINV(i)..  IT(i) =E= invr(i)/P(i) *ITOT ;
SAVINVEQ..  EXOSAV =E= sum(i, IT(i)*P(i)) - sum(hh, sshare(hh)*HHYD(hh));
*FINANCE..  exoincome =E= depr*sum(i, K(i))*RSTAR + retearnr*(CAPY+exoincome)
*              + CADEF - sum(hh, PRIVTRANSo(hh)) - FEDFLO - NEDFLO - EXOSAV;
LABMKTEQ..    LTOT =E= SUM(i,L(I));
PROPMKTEQ..   FTOT =E= SUM(i,F(I));
CAPMKTEQ..    KTOT =E= SUM(i,K(I));
OBJ..         OMEGA =E= SUM((i,hh), C(i,hh));

*    ######################    NEOCLASSICAL    MODEL    CLOSURE
######################
LTOT.FX = LTOT.L;
FTOT.FX = FTOT.L;
KTOT.FX = KTOT.L;
*ITOT.FX = ITOT.L;
*IT.FX(I) = IT.L(I);
*IT.FX("1")=IT.L("1");
```

```
EXOSAV.FX = EXOSAV.L;
*G.FX(i,gov) = G.L(i,gov);
GTOT.FX("fed") = GTOT.L("fed");
GTOT.FX("ned") = GTOT.L("ned");
GTOT.FX("ed")  = GTOT.L("ed");
NEDFLO.FX      = NEDFLO.L;
*INTAXR.FX("fed",hh) = INTAXR.L("fed",hh);
*INTAXR.FX("ed",hh) = 0;
INTAXR.FX("low") = INTAXR.L("low");
INTAXR.FX("med") = INTAXR.L("med");
INTAXR.LO("hi") = .001;
INTAXR.UP("hi") = .9;
INCTAXX.FX("ed",hh) = 0;
*PROTAX.FX(gov,hh) = PROTAX.L(gov,hh);
*P.FX(i) = P.L(i);
ER.FX = ER.L;
*     ########################          E N D     O F     M O D E L
#################################
OPTIONS ITERLIM=1500, LIMROW=0, LIMCOL=0;
MODEL TWOSEC /ALL/;
SOLVE TWOSEC USING NLP MAXIMIZING OMEGA;

*  #############  CONSTRUCT  SAM  FROM  SOLUTION  VALUES  OF  VARIABLES
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PARAMETER
    SAM1(isam,isam)       SOCIAL ACCOUNTING MATRIX
    ROWSUM1(isam)         ROW SUMS OF SAM ACCOUNTS
    COLSUM1(isam)         COLUMN SUMS OF SAM ACCOUNTS;

 SAM1("LABOR","IND1") = sum(ig, L.L(ig))*WSTAR.L;
 SAM1("LABOR","IND433") = sum(is, L.L(is))*WSTAR.L;
 SAM1("PROP","IND1") = sum(ig, F.L(ig))*PP.L;
 SAM1("PROP","IND433") = sum(is, F.L(is))*PP.L;
 SAM1("CAPITAL","IND1") = sum(ig, K.L(ig))*RSTAR.L;
 SAM1("CAPITAL","IND433") = sum(is, K.L(is))*RSTAR.L;
 SAM1("COM1","IND1") = sum((ig,jg), A(ig,jg)*X.L(jg)*P.L(ig));
 SAM1("COM1","IND433") = sum((ig,is), A(ig,is)*X.L(is)*P.L(ig));
 SAM1("COM1","HHLOW") = sum(ig, C.L(ig,"low")*P.L(ig));
 SAM1("COM1","HHMED") = sum(ig, C.L(ig,"med")*P.L(ig));
 SAM1("COM1","HHHI") = sum(ig, C.L(ig,"hi")*P.L(ig));
 SAM1("COM1","FED") = sum(ig, G.L(ig,"fed")*P.L(ig));
 SAM1("COM1","NONED") = sum(ig, G.L(ig,"ned")*P.L(ig));
 SAM1("COM1","EDU") = sum(ig, G.L(ig,"ed")*P.L(ig));
 SAM1("COM1","SAVINV") = sum(ig, IT.L(ig)*P.L(ig));
 SAM1("COM433","IND1") = sum((is,ig), A(is,ig)*X.L(ig)*P.L(is));
 SAM1("COM433","IND433") = sum((is,js), A(is,js)*X.L(js)*P.L(is));
 SAM1("COM433","HHLOW") = sum(is, C.L(is,"low")*P.L(is));
 SAM1("COM433","HHMED") = sum(is, C.L(is,"med")*P.L(is));
 SAM1("COM433","HHHI") = sum(is, C.L(is,"hi")*P.L(is));
 SAM1("COM433","FED") = sum(is, G.L(is,"fed")*P.L(is));
 SAM1("COM433","NONED") = sum(is, G.L(is,"ned")*P.L(is));
 SAM1("COM433","EDU") = sum(is, G.L(is,"ed")*P.L(is));
 SAM1("COM433","SAVINV") = sum(is, IT.L(is)*P.L(is));
 SAM1("IND1","COM1") = sum(ig, XXD.L(ig)*PD.L(ig));
 SAM1("IND1","CURRACC") = sum(ig, E.L(ig))*pe*ER.L;
 SAM1("IND433","COM433") = sum(is, XXD.L(is)*PD.L(is));
 SAM1("IND433","CURRACC") = sum(is, E.L(is))*pe*ER.L;
 SAM1("ENTER","CAPITAL") = CAPY.L;
 SAM1("ENTER","FINANCE") = exoincome;
 SAM1("HHLOW","LABOR") = sum(i, WMAT("low",i) * LABY.L(i));
 SAM1("HHLOW","PROP") = HHFY("low","propr")*PROPY.L;
 SAM1("HHLOW","ENTER") = entdis("low")*ENTY.L;
 SAM1("HHLOW","FED") = TRANSo("fed","low");
 SAM1("HHLOW","NONED") = TRANSo("ned","low");
 SAM1("HHLOW","FINANCE") = PTRANSo("low");
 SAM1("HHMED","LABOR") = sum(i, WMAT("med",i) * LABY.L(i));
 SAM1("HHMED","PROP") = HHFY("med","propr")*PROPY.L;
 SAM1("HHMED","ENTER") = entdis("med")*ENTY.L;
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SAM1("HHMED","FED") = TRANSo("fed","med");
SAM1("HHMED","NONED") = TRANSo("ned","med");
SAM1("HHMED","FINANCE") = PTRANSo("med");
SAM1("HHHI","LABOR") = sum(i, WMAT("hi",i) * LABY.L(i));
SAM1("HHHI","PROP") = HHFY("hi","propr")*PROPY.L;
SAM1("HHHI","ENTER") = entdis("hi")*ENTY.L;
SAM1("HHHI","FED") = TRANSo("fed","hi");
SAM1("HHHI","NONED") = TRANSo("ned","hi");
SAM1("HHHI","FINANCE") = PTRANSo("hi");
SAM1("FED","LABOR") = STAX.L("fed");
SAM1("FED","CAPITAL") = CTAX.L("fed");
SAM1("FED","COM1") = sum(ig, GS.L("fed",ig)*PD.L(ig));
SAM1("FED","COM433") = sum(is, GS.L("fed",is)*PD.L(is));
SAM1("FED","IND1") = sum(ig, ITAX.L("fed",ig));
SAM1("FED","IND433") = sum(is, ITAX.L("fed",is));
SAM1("FED","HHLOW") = HTAX.L("fed","low");
SAM1("FED","HHMED") = HTAX.L("fed","med");
SAM1("FED","HHHI") = HTAX.L("fed","hi");
SAM1("FED","FINANCE") = FEDFLO.L;
SAM1("NONED","LABOR") = STAX.L("ned");
SAM1("NONED","CAPITAL") = CTAX.L("ned");
SAM1("NONED","COM1") = sum(ig, GS.L("ned",ig)*PD.L(ig));
SAM1("NONED","COM433") = sum(is, GS.L("ned",is)*PD.L(is));
SAM1("NONED","IND1") = sum(ig, ITAX.L("ned",ig));
SAM1("NONED","IND433") = sum(is, ITAX.L("ned",is));
SAM1("NONED","HHLOW") = HTAX.L("ned","low");
SAM1("NONED","HHMED") = HTAX.L("ned","med");
SAM1("NONED","HHHI") = HTAX.L("ned","hi");
SAM1("NONED","FED") = fedned;
SAM1("NONED","FINANCE") = NEDFLO.L;
SAM1("EDU","IND1") = sum(ig, ITAX.L("ed",ig));
SAM1("EDU","IND433") = sum(is, ITAX.L("ed",is));
SAM1("EDU","HHLOW") = HTAX.L("ed","low");
SAM1("EDU","HHMED") = HTAX.L("ed","med");
SAM1("EDU","HHHI") = HTAX.L("ed","hi");
SAM1("EDU","FED") = feded;
SAM1("EDU","NONED") = EDTRANS.L;
SAM1("SAVINV","HHLOW") = sshare("low")*HHYD.L("low");
SAM1("SAVINV","HHMED") = sshare("med")*HHYD.L("med");
SAM1("SAVINV","HHHI") = sshare("hi")*HHYD.L("hi");
SAM1("SAVINV","FINANCE") = EXOSAV.L;
SAM1("CURRACC","LABOR") = sum(i, RADJ.L(i));
SAM1("CURRACC","CAPITAL") = CADJ.L;
SAM1("CURRACC","COM1") = sum(ig, M.L(ig))*pm*ER.L;
SAM1("CURRACC","COM433") = sum(is, M.L(is))*pm*ER.L;
SAM1("CURRACC","IND1") = sum(ig, INDIMP.L(ig))*pm*ER.L;
SAM1("CURRACC","IND433") = sum(is, INDIMP.L(is))*pm*ER.L ;
SAM1("CURRACC","HHLOW") = HHIMP.L("low")*pm*ER.L;
SAM1("CURRACC","HHMED") = HHIMP.L("med")*pm*ER.L;
SAM1("CURRACC","HHHI") = HHIMP.L("hi")*pm*ER.L;
SAM1("FINANCE","CAPITAL") = depr*SUM(i, K.L(i)*RSTAR.L);
SAM1("FINANCE","ENTER") = retearnr*(CAPY.L + exoincome) ;
SAM1("FINANCE","CURRACC") = CADEF.L;
SAM1("TOTAL","LABOR")    = SUM(isam2,SAM1(isam2,"LABOR")) ;
SAM1("TOTAL","PROP")     = SUM(isam2,SAM1(isam2,"PROP")) ;
SAM1("TOTAL","CAPITAL")  = SUM(isam2,SAM1(isam2,"CAPITAL")) ;
SAM1("TOTAL","COM1")     = SUM(isam2,SAM1(isam2,"COM1")) ;
SAM1("TOTAL","COM433")   = SUM(isam2,SAM1(isam2,"COM433")) ;
SAM1("TOTAL","IND1")     = SUM(isam2,SAM1(isam2,"IND1")) ;
SAM1("TOTAL","IND433")   = SUM(isam2,SAM1(isam2,"IND433")) ;
SAM1("TOTAL","ENTER")    = SUM(isam2,SAM1(isam2,"ENTER")) ;
SAM1("TOTAL","HHLOW")    = SUM(isam2,SAM1(isam2,"HHLOW")) ;
SAM1("TOTAL","HHMED")    = SUM(isam2,SAM1(isam2,"HHMED")) ;
SAM1("TOTAL","HHHI")     = SUM(isam2,SAM1(isam2,"HHHI")) ;
SAM1("TOTAL","FED")      = SUM(isam2,SAM1(isam2,"FED")) ;
SAM1("TOTAL","NONED")    = SUM(isam2,SAM1(isam2,"NONED")) ;
SAM1("TOTAL","EDU")      = SUM(isam2,SAM1(isam2,"EDU")) ;
SAM1("TOTAL","SAVINV")   = SUM(isam2,SAM1(isam2,"SAVINV")) ;
SAM1("TOTAL","CURRACC")  = SUM(isam2,SAM1(isam2,"CURRACC")) ;
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 SAM1("TOTAL","FINANCE")  = SUM(isam2,SAM1(isam2,"FINANCE")) ;
 SAM1(isam3,"TOTAL")      = SUM(isam2,SAM1(isam3,isam2)) ;
ROWSUM1(isam) = SAM1(isam,"TOTAL");
COLSUM1(isam) = SAM1("TOTAL",isam);

 OPTION DECIMALS=2 ;
 DISPLAY SAM1, ROWSUM1, COLSUM1 ;

*########## TABKES OF RESULTS FOR VARIABLES IN THE MODEL ##########

SET  sc  / ER,CADEF,FEDFLO,NEDFLO,EDTRANS,EXOSAV,CADJ,LTOT,FTOT,KTOT,
           WSTAR,W,PP,RSTAR,R,PROPY,CAPY,ENTY,DEPREC,RETEARN /

PARAMETER  SCALRES1(sc)  AGGREGATE VARIABLES RESULTS;
PARAMETER  SCALRES2(sc)  RESTART AGGREGATE RESULTS;
  SCALRES1("ER")        = ER.L ;
  SCALRES1("CADEF")     = CADEF.L ;
  SCALRES1("FEDFLO")    = FEDFLO.L ;
  SCALRES1("NEDFLO")    = NEDFLO.L ;
  SCALRES1("EDTRANS")   = EDTRANS.L ;
  SCALRES1("EXOSAV")    = EXOSAV.L ;
* SCALRES1("RADJ")      = RADJ.L(i) ;
  SCALRES1("CADJ")      = CADJ.L ;
  SCALRES1("LTOT")      = LTOT.L ;
  SCALRES1("FTOT")      = FTOT.L ;
  SCALRES1("KTOT")      = KTOT.L ;
  SCALRES1("WSTAR")     = WSTAR.L ;
  SCALRES1("W")         = W.L ;
  SCALRES1("PP")        = PP.L ;
  SCALRES1("RSTAR")     = RSTAR.L ;
  SCALRES1("R")         = R.L ;
* SCALRES1("LABY")      = LABY.L(i) ;
  SCALRES1("PROPY")     = PROPY.L ;
  SCALRES1("CAPY")      = CAPY.L ;
  SCALRES1("ENTY")      = ENTY.L ;
  SCALRES1("DEPREC")    = depr*sum(i, K.L(i))*RSTAR.L ;
  SCALRES1("RETEARN")   = retearnr*(CAPY.L + exoincome);

*SET  factor  / LABOR,PROPR,CAPITAL /;
PARAMETER  FCTRES1(fac,i)  FACTOR OF PRODUCTION RESULTS;
PARAMETER  FCTRES2(fac,i)  RESTART FACTOR RESULTS;
  FCTRES1("LAB",i)    = L.L(i) ;
  FCTRES1("PROPR",i)   = F.L(i) ;
  FCTRES1("CAP",i) = K.L(i) ;

SET  secvar   / P,PD,PE,PM,PX,PV,Q,X,XXD,E,M,ND,IT,IIMP,RADJ,LABY /
PARAMETER  SECTRES1(secvar,i)  SECTORAL PRICE AND QUANTITY RESULTS;
PARAMETER  SECTRES2(secvar,i)  RESTART PRICE AND QUANTITY RESULTS;
  SECTRES1("P",i)   = P.L(i) ;
  SECTRES1("PD",i)  = PD.L(i) ;
  SECTRES1("PE",i)  = pe ;
  SECTRES1("PM",i)  = pm ;
  SECTRES1("PX",i)  = PX.L(i) ;
  SECTRES1("PV",i)  = PV.L(i) ;
  SECTRES1("Q",i)   = Q.L(i) ;
  SECTRES1("X",i)   = X.L(i) ;
  SECTRES1("XXD",i) = XXD.L(i) ;
  SECTRES1("E",i)   = E.L(i) ;
  SECTRES1("M",i)   = M.L(i) ;
  SECTRES1("ND",i)  = ND.L(i) ;
  SECTRES1("IT",i)  = IT.L(i) ;
  SECTRES1("IIMP",i) = INDIMP.L(i);
  SECTRES1("RADJ",i) = RADJ.L(i);
  SECTRES1("LABY",i) = LABY.L(i);

SET   CONS / CLOW,CMED,CHI,FED,NONED,EDU /
PARAMETER  CONSUMP1(i,cons)  ABSORPTION BY HOUSEHOLDS AND GOVT;
PARAMETER  CONSUMP2(i,cons)  RESTART ABSORPTION BY HOUSEHOLDS AND GOVT;
 CONSUMP1(i,"CLOW")  = C.L(i,"low") ;
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 CONSUMP1(i,"CMED")  = C.L(i,"med") ;
 CONSUMP1(i,"CHI")   = C.L(i,"hi") ;
 CONSUMP1(i,"FED")   = G.L(i,"fed") ;
 CONSUMP1(i,"NONED") = G.L(i,"ned") ;
 CONSUMP1(i,"EDU")   = G.L(i,"ed") ;

SET  ftax  / LAB,CAP /
PARAMETER  FTAXES1(ftax,gov)  FACTOR TAXES;
PARAMETER  FTAXES2(ftax,gov)  RESTART FACTOR TAXES;
  FTAXES1("LAB",gov)    = STAX.L(gov);
  FTAXES1("CAP",gov)    = CTAX.L(gov);

SET  rev  / SALES, BUSTAXES,EXCTAXES,ITAXES,PROTAXES,INCTAXES,HTAXES /
PARAMETER  GOVREV1(rev,gov)  OTHER TAX AND SALES REVENUES;
PARAMETER  GOVREV2(rev,gov)  RESTART TAX AND SALES REVENUES;
  GOVREV1("SALES",gov)     = SUM(i, GS.L(gov,i)*PD.L(i));
  GOVREV1("BUSTAXES",gov)  = SUM(i, BUTAX.L(gov,i));
  GOVREV1("EXCTAXES",gov)  = SUM(i, EXCTAX.L(gov,i));
  GOVREV1("ITAXES",gov)    = SUM(i, ITAX.L(gov,i));
  GOVREV1("PROTAXES",gov)  = SUM(hh, PROTAX.L(gov,hh));
  GOVREV1("INCTAXES",gov)  = SUM(hh, INCTAXX.L(gov,hh));
  GOVREV1("HTAXES",gov)    = SUM(hh, HTAX.L(gov,hh));

SET  inc  / Y,YD,S,HIMP,CON /
PARAMETER  HHINC1(inc,hh)  DISTRIBUTION OF HH INCOME AND EXPENDITURE;
PARAMETER  HHINC2(inc,hh)  RESTART HOUSEHOLD INCOME AND EXPENDITURE;
  HHINC1("Y",hh)          = HHY.L(hh);
  HHINC1("YD",hh)         = HHYD.L(hh);
  HHINC1("S",hh)          = sshare(hh)*HHYD.L(hh);
  HHINC1("HIMP",hh)       = HHIMP.L(hh)*pm;
  HHINC1("CON",hh)        = SUM( i, C.L(i,hh)*P.L(i));

SET  ind  / LFED,LNED,LED,LINV,LLOW,LMED,LHI /
PARAMETER  INDEX1(ind)  DENOMINATOR FOR LASPEYRES QUANTITY INDEX;
PARAMETER  INDEX2(ind)  NUMERATOR FOR LASPEYRES QUANTITY INDEX;
  INDEX1("LFED")          = SUM(i, CONSUMP1(i,"FED"));
  INDEX1("LNED")          = SUM(i, CONSUMP1(i,"NONED"));
  INDEX1("LED")           = SUM(i, CONSUMP1(i,"EDU"));
  INDEX1("LINV")          = SUM(i, SECTRES1("IT",i));
  INDEX1("LLOW")          = SUM(i, CONSUMP1(i,"CLOW"));
  INDEX1("LMED")          = SUM(i, CONSUMP1(i,"CMED"));
  INDEX1("LHI")           = SUM(i, CONSUMP1(i,"CHI"));

 option decimals = 3 ;
 DISPLAY SCALRES1, FCTRES1, SECTRES1, CONSUMP1, FTAXES1, GOVREV1,
        HHINC1, INDEX1;
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